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THE TANJORE MAHARAJA SERFOJI'S ... MAHAL.

No. XXXI. SECOND SERIES. Dec. 1804.

Specification of the Patent granted to JOHN SHARRER WARD, *of Bruton, in the County of Somerset, Silk Throwster; for a Machine, upon new and improved Principles, for the Purpose of doubling either Silk, Cotton, Flax, Hemp, Worsted Yarn or other Threads.*

Dated December 30, 1800.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said John Sharrer Ward do hereby declare, that my said invention is described in manner following; that is to say: whatever number of threads are required to be doubled together of silk, worsted, cotton, flax, &c. they may by means of this invention be doubled to the greatest certainty, for if at any time any one of the threads, or union of threads, to be so doubled, should break, it will immediately stop the other thread or threads until the broken thread shall be repieced, which secures a constant double thread, or union of threads; and

and the manner in which the same is to be performed is described and ascertained in the plan hereunto annexed, and which is explained and referred to in the letters, figures, and words following; that is to say:

Fig. 1, (Plate I.) A, is a roller, turning round vertically or otherwise; with it is carried the bobbin B, which draws the threads C C from the bobbins D D, and consequently the balls E E and the thread wires F F will move round on the pins G G. H H, are two wood or iron standards, at the tops of which are hung two regulating thread wires I I. When either of the threads C C break, the thread wire through which it passes falls down, and the tail part K rises up to a level with the ball E, and stops the other thread wire F from going round, and consequently the thread that passes through it, and prevents the bobbin B from taking it up; but the roller A continues in motion. L L, are guide wires for the threads to pass over. M, is a slide, moved by a stort wheel or crank to lay the threads level on the bobbin.

Fig. 2, is another doubling machine; the form varied, but the principle the same as Fig. 1. A, a roller, turning vertically, whereon lies a smaller one marked B, the axis of which goes through the bobbin. C, a slide, for the same purpose as M in Fig. 1. D D, two bobbins, with spindles through them; on each of which is fixed a wheel E E. F F, are two thread wires, hung at G G. When either of the threads break, the wire drops between the teeth of the wheel and stops the other thread, the bobbin and roller B stopping at the same time, but the roller A continues moving as A in Fig. 1.

In witness whereof, &c.

Specification

Specification of the Patent granted to JOHN SLATER, *of Huddersfield, in the County of York, Surgeon; for a new and improved Method of manufacturing and fabricating of Cables, Shrouds, Stays, and other Articles for the rigging of Ships, of Materials never before used for that Purpose.* Dated January 19, 1804.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said John Slater do hereby declare, that my invention consists in substitution of metals in lieu of hemp in the fabrication of cables, shrouds, stays, and other articles for the rigging of ships, which is to be applied in the form of chain-work, and which every workman in chain-work knows how to make without farther instruction.

N. B. I claim no discovery in the construction of chains, but solely to the application of them for the purpose of rigging of ships, of whatever form, metal, or metallic substance, they may be constructed.

In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

By way of elucidation, it is to be observed, the invention, consisting of chain-work, is chiefly intended for standing-rigging; the links are made of a short oval form, very thick in proportion to their size, and every two nearly touching in the centre of the third, in which they are inserted, the weight of the different articles to be the same as the cordage now in use. The mast-heads are to be surrounded with a plate of rolled iron or cop-

 per,

per, to keep the shrouds from chafing. One leg of a pair of shrouds is to be received through a large link in the other, just at the place where the present kind are seized, and they are to be set up with dead-eyes (having metal straps and hooks to hook into the ends of the shrouds) and lanniards, as in the present manner. The fore-stays are to be hooked where they are now seized, and the back-stays fitted in the same manner as the shrouds.

The advantages of this invention must be obvious to every person skilled in maritime affairs, as the durability of one suit of rigging would exceed that of any ship made of the best materials; and, as there would be no sensible stretching in any climate or weather, it would entirely obviate that serious inconvenience by which many a ship has lost her masts, and ultimately both cargo and hull, as it is no easy matter, and frequently impossible, to set the shrouds up in a heavy gale, or even secure them in any manner that will preserve the masts, of which there have been too many lamentable instances.

This substitute for cordage will never require any mechanical stretching, but will always be the same, and will never be troubled with kinks, but always pliant and easy to handle, will require no serving, leathering, or chafing mats, will never require flitting, and the ratlins may be fixed to this as easy as hempen rigging. In time of action this kind of rigging will be much less liable to be cut with shot from its greater cohesion, elasticity, and slipperiness, and, in case of its being cut, may be much more easily repaired, which can be done instantly, by passing a piece of small line two or three times through the links immediately above and below the fractured link, and heaving it tight by hand, which will be a sufficient security during the engagement, and keep the ends from

hanging

hanging down; and when the action is over, a link made for the purpose, in the same form as the others, but a little stronger, and wanting a piece at one side thus C, may easily be inserted, by slackening the lanniard, which, after heaving it tight again, will look as well as ever, and be perfectly secure, till it is convenient to have it taken down and repaired at the forge.

This kind of rigging has a much lighter and more beautiful appearance to the eye, as it looks handsomely beaded, and when blacked over lightly with lamp-black and pitch is effectually preserved from rust. When the demand requires it to be made in any great quantity, the first cost will be nearly as small as that now in use; and when the time comes that it does wear out, every particle of it can be manufactured over again.

If it was adopted in the British navy, the saving would be almost incalculable to this country, and there would be no loss, as the present kind could be replaced by it as it wore out. But the want of patronage will no doubt be a means of preventing the country from reaping the advantage it would otherwise derive from its adoption. The only objection which has been made against it, and which seems to have any weight at first sight, is its supposed attraction for the electric fluid; but upon mature consideration, founded upon observation, it will have no weight at all except in its favour. It is well known that iron in particular, and metallic substances in general, are conductors to lightning; but that the power of attraction at any distance is very trifling is evident from the many spires with iron rods in them having stood uninjured for ages, also ships masts with iron spindles for their vanes. Buildings furnished with electric rods, iron balconies, &c. are seldom struck, and when they are, it as frequently happens they are injured where the metal is not

as where it is; it is certain when the fluid does strike the metal, it will follow every turn it makes till it reaches the surface of the earth, which is a strong reason for the adoption of metallic rigging, as in case of a ship being struck with lightning, the shrouds having small appendages to let down, it would be conducted into the water without injury to the crew, ship, or cargo, except a man happened to be on the shrouds where, or leading from where it fell; and it is presumed that accidents of this kind would more seldom happen than does at present, as the men upon deck, in the tops, and on the yards, would be almost intirely secure, which is not the case at present; and in climates where the surrounding atmosphere is pregnant with the electric fluid, no accumulation could take place, as the rigging would be continually conducting it harmless to the surface, in the same manner as a chain suspended from the conductor of an electric machine, and resting on the ground, would prevent a person touching it from receiving a shock.

The chain-work is recommended to be made of the toughest iron, and well welded, as indifferent iron would not answer the purpose; it likewise may be made of copper, &c.

The Patentee's engagements being foreign from the nature of this invention, he consequently cannot attend to the subject of it, and therefore wishes to dispose of the patent. He is willing either to part with it wholly or in shares.

Specification

Specification of the Patent granted to Mr. John Bywater, *of the Town and County of the Town of Nottingham; for a Method of clothing and unclothing of the Sails of Windmills while in Motion, (providing they are made after the Dutch Manner, or as the generality of Sails are constructed,) by which the Mill may be clothed either in Whole or in Part, in an easy and expeditious Manner, by a few Revolutions of the Sails, whether they are going fast or slow, leaving the Surface smooth, even, and regular in Breadth from Top to Bottom; and in like Manner the Cloth, or any Part thereof, may be rolled or folded up to the Whip at Pleasure, by Machinery simple and durable, requiring very little Alteration of any Part of the Mill, may be fixed up in a few Days, at a comparatively easy Expense, and is equally applicable to any old Sails, however warped or bosomed, without the Necessity of having new Cloths.* Dated September 14, 1804.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said John Bywater do hereby describe the nature of my said invention to consist in rolling or folding up to the whip, and unrolling or unfolding again, the cloths of common windmill sails while in motion, by means of cylinders or rollers of any shape as long as the sails, with a toothed wheel at one end of each, working either directly or indirectly into two wheels without arms, which are hung so as to turn upon a ring of iron fixed to the shaft head close behind the back stocks, and which may be alternately stopped; so that the wheels at the ends of the cylinders must directly, or by means of a connexion of wheels called carriers or nuts, work into them by revolving

volving round them through the power of the wind acting on the sails; so that the cylinders must necessarily turn round and roll up or fold, or unroll or unfold the cloth which is fastened to them, according to the respective wheel without arms, which is stopped as aforesaid, for that purpose. It appears to me necessary, lest others encroach on my patent, to describe as above the general end, result, and use of my invention, which has so long been the wish of the millers to obtain; and the attainment of which I have constantly had in view, namely, to clothe and unclothe common windmill-sails while in motion, and to leave any quantity of cloth on the sails at any time in an even breadth from top to bottom; and also to describe, as above, the principle upon which I act in as few words as possible, and in such a manner as will make the matter as plain as the case will allow. Therefore, according to what is set forth and declared, persons who shall roll or fold up to the whip, or unroll or unfold the cloths of the sails of the common windmills while in motion, whether by the means above described, or any other, without my permission, are deemed to encroach on my patent, as this effect of so clothing and unclothing of common windmill-sails was never accomplished and made known prior to my said invention. And I should deem the above description of the mode of performing the same adequate to answer all the ends of a full and plain description of my invention, to be enrolled in the Court of Chancery, as has been done in similar cases. And I think it not anywise of moment to subjoin any drawings to explain the same, as it can by no means be possible to hide or conceal the windmills so to be improved; but to comply, as strictly as possible, with the letter of the said proviso, I have given the annexed drawings and explanation.

Figs.

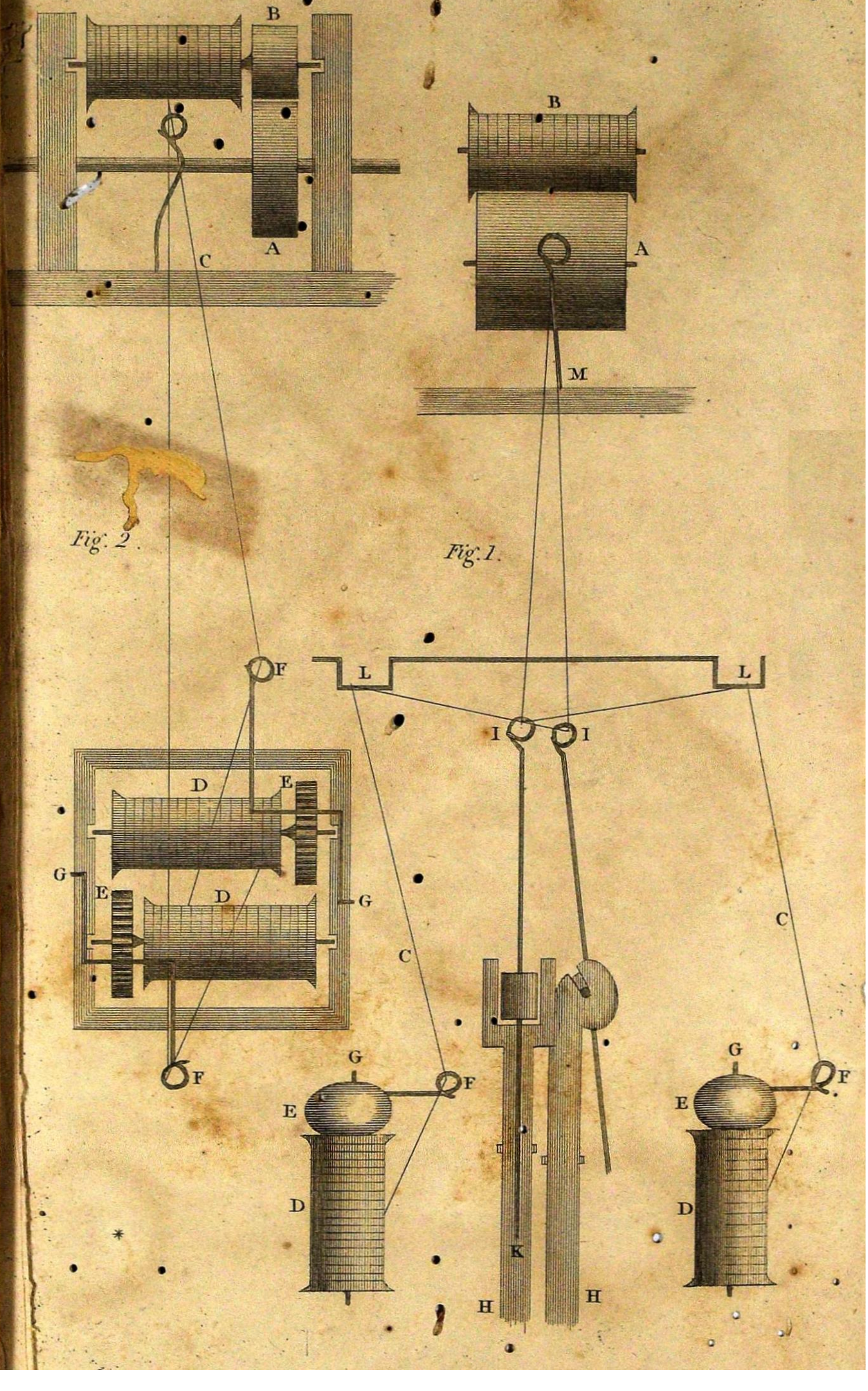


Fig: 2
Fig. 1
A
B
C
D
E
F
G
H
I
K
L
M

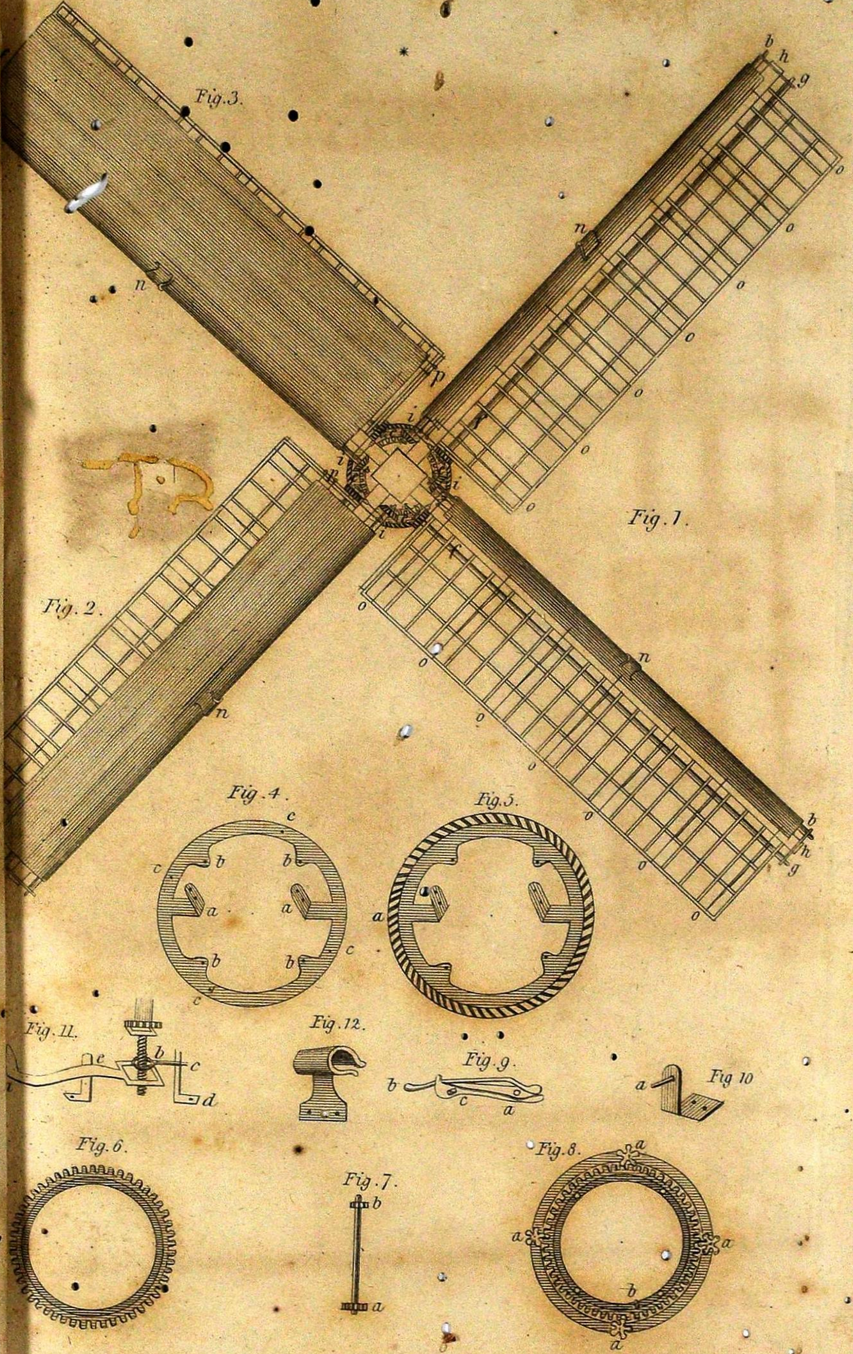
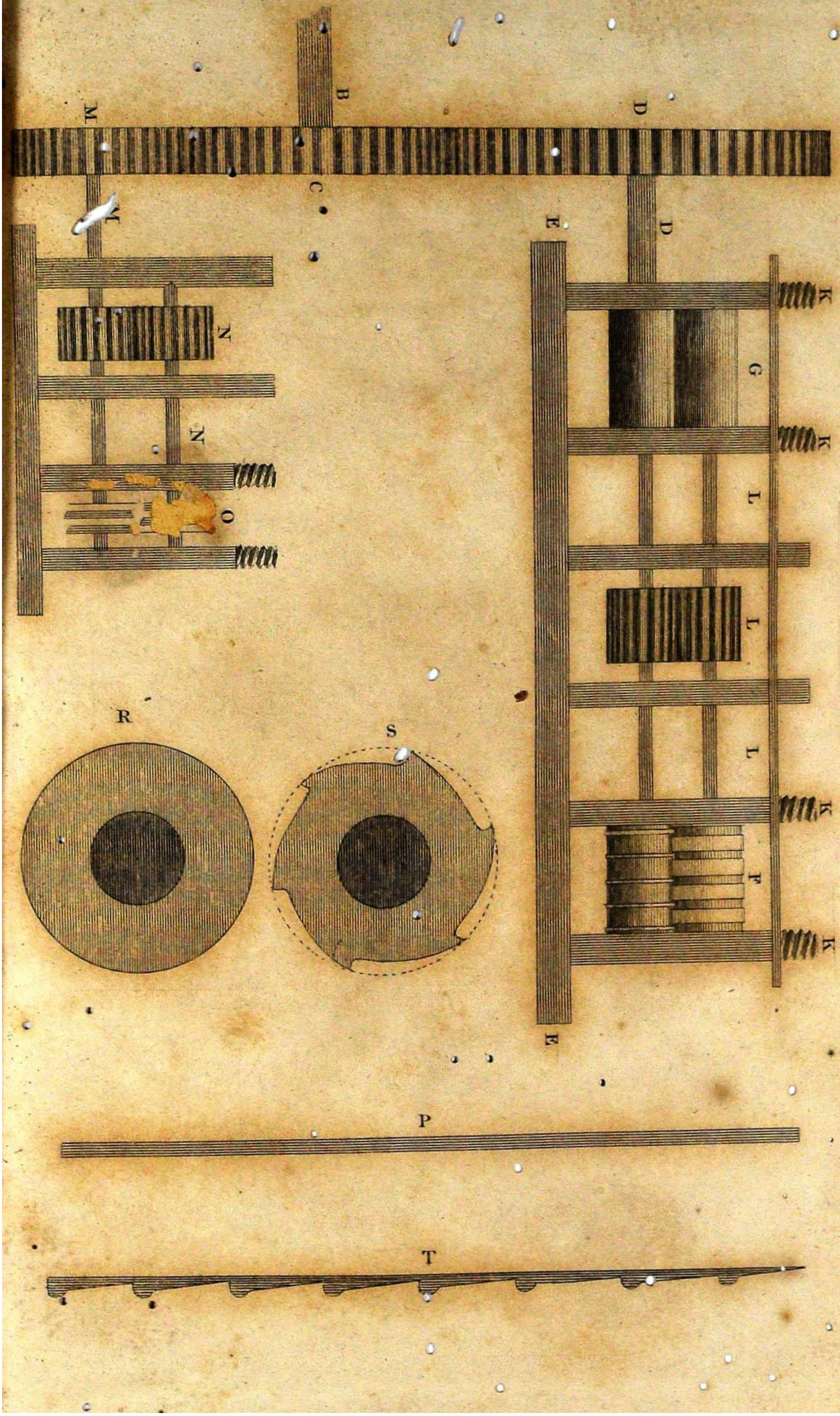


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig 10
Fig. 11.
Fig. 12.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Figs. 1, 2, 3, (Plate II.) are front views of the sails as unclothed, half clothed, and clothed *.

Fig. 4, a ring of iron, or other material, about four inches wide and three-quarters of an inch thick (more or less as required), whose diameter must be sufficient to embrace the shaft-head, to which it must be well secured by the stays *a a*, or otherwise.

Fig. 5, a bevelled wheel, without arms, made of iron, or other material, stayed on the edge of the ring so as to turn easily.

Fig. 6, a spur-wheel of iron, or other material, without arms, made to turn easily on four pins fixed into four ears *b b b b*, in the back of the ring; which pins are turned up at their ends to keep it steady.

Fig. 7, is one of the four spindles of iron, or other material, with a spur nut *a* and a bevelled nut *b*; this spindle passes through Fig. 4, at *c c c c*, and the nut *a* works into the spur-wheel as seen in Fig. 8, *a a a a*. The four bevelled nuts (Fig. 7, *b*) work into the bevelled wheels at the end of four cylinders *i i i i*, Figs. 1, 2, 3, and so turn them; and two of these spindles must be shorter than the others when the stocks are not flush. These cylinders are made of wood, or other materials, diameter three inches, more or less, or made octagon, or any other shape; one to be placed at the outside of the leading edge of each sail, round which the cloth is rolled (one edge being fastened on for that purpose) when the sail is unclothed. A gudgeon from the end of each cylinder runs into an iron fastened to the shaft-head, and is kept in its place by a nut screwed to its

* In the specification there are three drawings, representing four vanes each, clothed, half clothed, and unclothed, but to save the space that they would have occupied in our plate we have shewn one figure only, exhibiting two vanes unclothed, one clothed, and the other half clothed.

its end. The other end has a gudgeon *b*, which turns in the eye of the cross iron *h* at the points of the whips. *ffff* four cylinders, similar to *i i i i*, placed on the inside the whips, one behind each sail to clothe the sails, by means of ropes *o o o o*, &c. (fastened to them and the edge of the cloth.) At the end of each of these four cylinders a nut or wheel is fixed, *e e c e*, to work into the bevelled wheel Fig. 5, whose teeth decline from the centre in proportion as these work from it, which declination must be reversed when the sails turn the contrary way, and gudgeons to run into irons either projecting from the ring or fastened to the shaft-head like the other cylinders. The gudgeons *g* keep these cylinders steady in the cross iron *h* at the point of the whips, and stays of any shape or number will keep them from springing.

Now, suppose the mill fully clothed, as Fig. 3, all the parts of my machinery revolve with it undisturbed until a lever, Fig. 9, (which turns on the centre pin *a*, Fig. 10, by which it is fastened to the braces or fencings, and whose end *b* is weighted to hang down towards the breast of the mill,) being brought into an horizontal direction by pulling a string attached to the end *a* withinside the mill, the end *b* stops the stud *b*, projecting from the inner surface or back-front of the spur-wheel Fig. 8; consequently the four spur nuts *a*, at the end of the spindle Fig. 7, (and seen at *a a a a*, Fig. 8,) roll round the spur-wheel, and the bevelled nuts *b* at the other end of the spindle work into the bevelled wheels of the outside cylinders *i i i i*, Figs. 1, 2, 3, in a straight direction behind them, and so turning the cylinders roll the cloth on them till it is rolled up to the whip. The lever is then driven sidewise (its spring *c* returning it again) from the stud in the back face of the spur-wheel by the following contrivance.

A screw

A screw *b*, Fig. 11, is cut on the gudgeon of any one of the cylinders behind the sail, and a piece of iron *c*, Fig. 11, is tapped to fit it. The end of this iron runs into a slot in the iron *d*, Fig. 11, made fast to the shaft-head, to prevent the iron *c* from turning with the cylinder, but allows it to slide up and down so as to press on that on the iron *a*, Fig. 11, which has the eye in it, and raises the end *a* just high enough to drive the lever aside when the cloth is all rolled up, the threads of the screw adjusting it to what number of revolutions you choose to employ for that purpose. The point-end of the iron *a*, Fig. 11, is that part of it which pushes aside and passes the lever Fig. 9, and moves on its centre *c*, and must be carried under the spur-wheel so as to act behind it for that purpose: a duplicate of Fig. 11 shews it on a larger scale *. By letting go the string the miller may at any time leave the cloth on the sail where he chooses, likewise the sails may be clothed, or any part thereof, by a lever, similar to *a*, Fig. 9, stopping the stud *a*, on the edge of the bevelled-wheel Fig. 5, and driven off in a manner similar to the spur-wheel.

Fig. 12, is a stay of wood, or other material, and fixed to the stock or whip at *n n n n*, Figs. 1, 2, 3, to prevent the cylinders from springing too much. In the inside there is left room enough for the cloth to be rolled upon the cylinder through its lips in the eye of this stay. In order to keep the strings tight in all weathers, which go over the edge of the shrouds, *o o o o*, &c. a cord, passing over a spring of any sort or shape, placed under the sail, is fastened to, and wound about, the upper ends of the cylinders in a direction contrary to the strings and cloth. To prevent the cloths from being driven downwards by the centrifugal force, a ring or two are left on to run along the rods in the old manner, as *p*, Figs. 2 and 3.

* The smaller drawing is omitted in the plate.

The width of the cloth, diameter of the cylinders, and number of revolutions you choose to employ to roll up your cloth, must determine the size of the wheels. In order to fold the cloth instead of rolling it, one end of it must be fastened to the whip and lines passed across the outside of it through loops fastened to its edge, and continued over the edge of the shrouds, and connected with the cylinder or roller, of any shape, placed under the sail, or elsewhere, the other ends of the lines must also be connected with the said cylinder or roller; and when the cloth is drawn up in folds towards the whip, so much of these lines will be rolled on the cylinder one way, and off from it the other, as will be sufficient to let out the cloth again when the same cylinder, turned the contrary way, draws the cloth on the sail. By this mode I get rid of four cylinders, with their appendages, the work being in other respects the same as in rolling the cloths; but since folding gives a surface much inferior in many respects to rolling, and induces inconveniences and accidents from which the rolled surface is free, I shall advise the rolling, rather than for a small saving to endure the inconveniences of folding.

Note. The above drawings are a quarter of an inch to the foot *.

If a sudden gust of wind should arise in the absence of the miller, so as to drive the mill faster than a given velocity, a pair of centrifugal balls, like the governor of a steam-engine, may be so placed as to adjust the lever so that she may immediately unclothe herself; but as this is not an essential part of my patent, it may or may not be adopted.

In witness whereof, &c.

* In our plate Figs. 1, 2, and 3 are reduced about two-thirds less than the original, but the remaining figures are nearly on the same scale.

OBSER-

Observations by the Patentee.

The various and repeated attempts that have so long been made to discover a ready and effectual method of controlling the excessive power of the wind, acting on so large a body as a windmill, engaged my attention some years since; and the eagerness shewn to obtain patents for new inventions, that were considered as improvements, led me to suppose that some great advantages, individual or national, were involved in the issue. Experience soon proved the general error that more or less pervaded all their schemes; for every one followed his predecessor in adopting sails varying from, or quite on a different construction to, those in common use, either by laying the cloth on in a different manner, or by using boards instead of cloth, hung like Venetian blinds; or by entirely taking away the shrouding and bars, and suspending the cloth at the corners by ropes; and by introducing many different contrivances; all agreeing only in one object, that of departing from the old established mode of laying the cloth on the sails in the way which common usage has sanctioned, and experience abundantly confirmed, as the best possible way of doing it. Reflecting hereon from time to time as the subject occasionally presented itself, I was at length induced to devote a small portion of the time I could spare from my regular employment to the more immediate consideration of the subject, to contrive a method that might embrace all the beneficial ends that could be wished, and which should at the same time be as free as possible from the inconveniences that, more or less, affected attempts of a similar nature. My leading design was to meet the wishes of the millers, and to do the business *in their own way*, by rolling the cloth, or any part of it, *up to the whip*, in an easy and expeditious manner, by the agency of the miller

miller himself, who should only have to pull a rope within side of the mill, at any time he wished to reduce the cloth, to leave as much as he chose of it on the sail, and to return it again at pleasure, *the mill all the while continuing in motion.* I accordingly constructed a model, which, with successive alterations, I have so improved, as to render it every way answerable to the general wish. The machinery I make use of being chiefly made of cast-iron, not heavy nor cumbersome, is both cheap and durable; and as the whole may be got in readiness, and fit to put together, before it is sent to the mill, the time lost in putting it up can seldom exceed a week or ten days; and dimensions may be sent, by post, to the patentee from any distant part, by which he can prepare his machinery, without the necessity of previously viewing the mill. The advantages arising from my invention will easily appear by contrasting it with the numerous disadvantages under which the millers at present labour. Those who occupy windmills well know the danger they are often exposed to from sudden squalls of wind, and hard gales continuing and encreasing while the sails are clothed and going, which are often incapable of outriding the storm. The shafts, if not wrung off their necks, by the frequent application of the break, are so cripled and weakened as to be rendered unfit to be trusted after repeated injuries of this kind, and various other mischiefs arise in consequence. The uncertainty of the wind, and the danger in long and dark nights, often deter the miller from grinding when he is in the greatest need; and the time and trouble necessary to stop the mill and alter the cloth so frequently in unsettled weather, are such as to disable him from doing a great proportion (perhaps half) of the work which could otherwise be done at those times. By the assistance of my machinery, all these in-

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conveniences will be wholly remedied. The miller without stopping the mill may, in six or eight seconds, unclothe the whole of the sails if necessary, or instantly so effectually relieve the sail by drawing the cloth from the thin edge towards the whip as to secure his stocks from the twisting and straining to which they are otherwise liable, and relieve the shaft from the injuries resulting from the application of the break; and thus not only will much time be saved, but also a considerable reduction be made in the expense of repairs. Besides the advantages above described of doing *safely much more work in gusty weather;* I can at a small additional expense afford the miller more power, by exposing a greater surface of cloth in *low winds* than prudence would allow him to adopt, without the constant and ready control which by this machinery he will always be able to exercise over the wind. My method of laying on the cloth, in an even breadth from top to bottom, far exceeds the common way of partly unclothing by rolling a portion of the cloth diagonally to the point of the whip, as a long and regular surface from top to bottom makes her go much more steady in strong gales and sudden squalls without so hastily feeling the effect of the wind's dying away. The firmness with which my machinery may be fixed to the shaft-head, and the few dependencies it has, in comparison of others, will, it is presumed, secure it from getting out of order, and from the heavy complaints and strong objections that have been brought against others on that account: and as I have now applied my improvement to as old a mill as most in the country, which, although the shaft-head is as crazy and rotten as can readily be met with, performs with ease and safety, I feel no hesitation to engage to put it up to *any old mill*, that is but in a working state, let the sails be as much twisted and bosomed as possible, and insure its performing its work for any given time.

The endeavours that have been hitherto made, to make the wind generally do the work itself, has exposed the machinery to be so constantly teazed and fretted, and so liable to be out of order, so much expense has been indured and time lost in fixing it up, and so much attention required, to oil and keep it in order, as to prevent the universal application of such improvements to common windmills; but for a moderate additional charge centrifugal balls may be adapted to draining-mills in the fens with my machinery, so as to make the mill unclothe or clothe herself when she is going at a velocity *beyond* or *less* than a given speed, while at all the intermediate degrees the machinery will be constantly at rest though the mill will continue in motion. And this might be applied to windmills in general, but my improvement is on several accounts preferred by the millers without that addition.

Specification of the Patent granted to Booth Hodgetts, *of Dudley, in the County of Worcester, Nail-Ironmonger; for certain Improvements on Machinery for rolling Iron for Shanks, and forming the same into Shanks for Nails.* Dated November 8, 1803.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Booth Hodgetts do hereby declare, that my said invention of certain improvements on machinery for rolling iron for shanks, and for forming the same into shanks for nails, is particularly described and ascertained in the drawings and description thereof hereunto annexed. In witness whereof, &c.

A (Pl. III.) the inside of a mill, commonly used for rolling bars, and slitting or cutting them into rod iron. B, the shaft

which

which connects the machinery, with a wheel to be worked either by steam or water. C, the spur-wheel. D D, the wheel and shaft which work the rollers. E E, the bed which the standards are fixed upon. F, the rollers to roll blooms or slabs of iron into bars. G, the rollers to roll bars or pieces of iron to a proper thickness before they are cut or slit into rods. K K K K, the iron standards in which the rollers work, with screws to keep them at a proper distance from each other. There are four standards to each pair of rollers, though the front-view can shew only two. L L L, the pinions and connexions. M M, the wheel and shaft that work the cutters or slitters. N N, the pinions and connections. O, the slitters or cutters and the iron pillars with screws in which they work: there are four pillars, though the front-view shews only two. P, the edge of a bar of iron after it has been rolled with common rollers before it is slit into rods.

My improved way of rolling and cutting iron so as to form those parts of nails called the shanks is as follows.—A pair of rollers (which I put in motion by the machinery above described, or any other mechanical power) are thus prepared: one of them in the usual way, round, see letter R; the other roller (letter S) is cut, indented, or grooved, so as to roll a bar or piece of iron, thick and thin (see T), in proper lengths, according to the nails wanted; that is, one end of each length must be left thick enough to make the head, and then gradually tapered to the other end till thin enough to form the point. The dotted circular line shews the end-view of the roller in the form it was before cut or indented; and the black lines shew the form and manner that the grooves are cut or indented on the roller, and represent it in its improved state. The grooves may be either cut quite across the roller S from one end to the other, to make all the shanks of

of one length or sort, or may be cut in divisions so as to make different sorts or lengths. T, shew the edge of a bar of iron after it has been rolled in or between the rollers R and S, in which state it is then to be cut or slit into proper breadths in such slitters or cutters as are generally used in an iron-slitting mill. The nail-shanks are afterwards separated from each other and smoothed, and then headed in the usual manner. Brads do not require to be headed.

Account of Improvements of Boggy Land.

By BENJAMIN WADDINGTON, *Esquire, of Lanover-House, near Abergavenny, in South Wales.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was presented by the Society to the Author for this Communication.

HAVING in the year 1798 determined to plant with larches, ashes, &c. about twelve acres of pasture-land, situated not far from my house, the soil of which is gravelly and partly boggy, and which had not been by any means productive, I ploughed it up, and obtained from it that year an indifferent crop of potatoes. It being bounded on the lower side by a brook, I had a bank thrown up; and in November, 1798, I made a willow fence, such as Dr. James Anderson has recommended in his "Essays on Agriculture," &c. &c. In March, 1799, I received from Glasgow 108,000 larches and 5000 ashes, part of them seedlings and part transplanted. I had the larches put into the ground as soon as possible, two feet apart, in rows, as recommended by Dr. Anderson, in his

his third volume of Essays. The 5000 ashes, and 2000 more which I procured in this neighbourhood, I planted according to the judicious method recommended in Article twenty-two of the fifth volume of the "Bath Society's Papers," &c. I state it thus concisely, from not having time to describe the method more fully. A considerable number of the larches having been much injured in a long passage from Glasgow, in December, 1799, I procured 12,000 transplanted ones, to fill up vacancies; and in another part of the same ground I planted 2000 spruce firs by themselves, two feet apart, and 1000 Spanish chesnuts likewise by themselves. Part of the ground being still unoccupied, in October, 1800, I ordered from Glasgow 21,600 more larches, which arrived in February, 1801, and were immediately planted. Several of them having died in the course of that year, I procured, in December, 1801, 14,400 more, and 2,400 English or Scotch elms. The larches were made use of to fill up vacancies, and a part of the ground that was still unplanted; and the elms were put into the ground principally near the hedge-rows round the plantation, and other parts of my estate. All those that came last were transplanted trees, from one and a half to two and a half feet long; and having arrived in excellent order, they have completed the plantation, excepting about a quarter or half an acre, at present a bog, which it is my intention to cut drains through, and to plant with ashes this winter.

I have the pleasure to say, that the whole, or nearly the whole, of the larches and ashes, appear now to be in a very flourishing state, some of the former being twelve feet three inches high, and many of them ten feet. I have found the transplanted trees to thrive the

 best.

best. The ashes are many of them six feet four inches high; and they made by far the greatest shoots this year. About half of the Spanish chesnuts are in a thriving stase, and almost all the elms. Half of the spruce firs have died; but the remainder have lately made great shoots, as have likewise about 2 or 300 oaks introduced in different places.

I am persuaded I may safely say, that there are at present no less than twelve acres of indifferent land in a fine growing state.

110 to 120,000		Larches,
6000	————	Ashes,
2400	————	Elms,
1000	————	Spruce Firs,
500	————	Spanish Chesnuts,
200	————	Oaks.

As I was induced to make this plantation in consequence of observing a growing scarcity of timber of all descriptions in this country, owing to a large consumption by several very extensive iron-works, that have been erected within these fifteen or twenty years, I shall probably ere long plant the whole, or part of another tract of land (nearly fifty acres) which I have in an elevated situation, with larches, where I have no doubt they will flourish, and become very valuable to my children, and to the public.

Improvements

Improvements in Pendulum-Clocks, by diminishing the Friction in Escapements.

By Mr. EDWARD MASSEY, *of Hanley, Staffordshire.*

With a Plate.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

Fifty Pounds were voted by the Society to Mr. MASSEY *for this Invention.*

HAVING for a considerable time considered a method of diminishing the friction in escapements of pendulum-clocks, which I conceive may be of great service in making better time-keepers, by relieving the pendulum from obstructions occasioned by friction in the train of wheels, and on the acting-part of the pallets, I beg leave to lay before the Society for the Encouragement of Arts, &c. two escapements, which I have no doubt will answer the purpose intended. The difficulties which I propose to diminish in clock-escapements by this invention are as follow: first, it is allowed, that when the pressure against the recoiling-escapement is diminished, as it is liable to be, from increase of friction in the wheel-work, the vibrations of the pendulum will not be performed in so short an interval. This circumstance has the contrary effect on a dead beat; for when the pressure against the locking is the greatest, the vibrations will occupy a longer interval of time; so that the vibrations of the pendulum are liable to be affected from two causes — from an increase of friction on the acting-part of the pallets, and from an increase or variation of friction in the train of wheels. These are the objects which I have bestowed great pains and expense to remove.

I beg

I beg leave therefore to give a description of two models * of my improved escapement that accompany this letter. First, a swing wheel is made in the usual way of making it for a dead beat, except that it is not necessary to make the teeth with fine points. The pallets, instead of being fixed on the verge in the usual way, are fixed on two light detents, one on each side of the swing-wheel. The lockings are on the inclined planes of the pallets, which are pressed against the teeth of the swing-wheel by remontoiring springs, which should be under the command of the weight or main-springs, so that if an increase of friction should take place in the wheel-work, the vibrations of the pendulum will not be much affected, so long as there remains a power to raise the inclined planes. A momentum is communicated to the pendulum through these inclined planes, by two arms fixed on the verge, which come into contact with them, and unlock one on each vibration of the pendulum. Thus, suppose a momentum to have been given by the inclined plane on the right; at the same time that this takes place the wheel moves forward, and raises the inclined plane on the left, and the pendulum, having performed its oscillation to the left, receives a momentum from the inclined plane, to compensate for the loss of power which would take place during the ensuing vibration to the right, and so on alternately. The advantage in this model consists, I conceive, in diminishing the friction in the acting part of the pallets, in giving a regular certain momentum, independent of any variation which may occur in wheel-work, or on the acting-part of the pallets, except during the short time of unlocking.

* Preserved in the Society's repository for public inspection.

The

The second description, being a free pendulum without a verge, is as follows: the swing-wheel must be on the outside of the back plate. The pallets are formed like a pair of tongs, and are a fixture to the clock. There is a spring fixed in the upper part of the tongs, which keeps them extended against the points of the adjusting screws. The points of the tongs are pallets, with inclined planes, and have lockings, as the one above described. The tongs are made to spring from the point by which the pendulum is suspended, and by altering the adjusting screws a proper tension may be given to the spring-part of the pallets; but they must be sufficiently under the influence of the main power. I think the main power should be about one-third more than is necessary to raise the inclined plane so as to allow for an increase of friction, which may take place in the wheel-work. There must be a cross piece fixed to the pendulum, which must come into contact with two pins that are fixed in the inclined planes of the pallets, so as to unlock one on each vibration of the pendulum. Suppose the pendulum to be put in motion, and to have unlocked the inclined plane on the right; the wheel moves forward, and raises the inclined plane on the left, at which time the pendulum receives a momentum from the spring-pallet on the right, and, after performing its excursions to the left, receives a momentum, as on the right, and so on alternately. The advantage of this escapement over that above described is, that it avoids the friction of the verge and detent pivots, and during a part of the vibration the pendulum is disengaged, so that it is a free pendulum.

RE-

References to Plate IV.

Fig. 1.—*First Method.*

A. The swing wheel.

B C. The two pallets.

D D. The detents on which the two pallets B and C are fixed.

E. One of the *remontoire* springs on the left side; another, similar to this, is on the right side of the frame, but is not shewn in the plate.

F. The verge.

G. The arms fixed on the verge, which act on the pins H I of the pallets.

K. The pendulum, fixed in the usual way on the verge.

Fig. 2. — *Second Method.*

a. The free pendulum without a verge.

b. The swing wheel on the outside of the back plate.

c d. The pallets, formed like a pair of tongs.

e. A spring, which keeps them extended against the points of the adjusting screws.

f g. The points of the pallets.

h i. The adjusting screws of the pallets.

k. The cross piece fixed to the pendulum, which piece, as the pendulum moves backwards and forwards, comes in contact with the two pins on the points of the pallets *f g*, and relieves the wheel.

The pendulum is supposed to be in motion, and the dotted lines show those parts of the machine which are hid by others.

On

On the Husbandry proper for a Gentleman.

From Hunter's Georgical Essays.

WITH regard to gentlemen occupying large tracts of land, unless they sacrifice all other pursuits to their farm, or be uncommonly fortunate in their choice of a steward, they will find an endless trouble in their undertaking, and most probably be glad to quit it with considerable loss. But if a gentleman spends a considerable part of the year in the country, and has a constant family establishment with occasion for some horses; the expenses both of his house and stables will be considerably reduced by the occupation of about sixty acres of good land, or one hundred acres of an inferior quality. In the first case, it would be convenient to divide his farm into four arable fields, of eight acres each, and four pastures of seven acres each. Let the arable lands be brought into a course; that there may be every year one field sown with turnips, or planted with cabbages (as the soil is dry or wet); one with spring-corn, after the turnips or cabbages; one with clover, tares, beans, or pease, after the spring-corn (the beans or pease to be kept perfectly free from weeds); and one field sown with wheat after the clover, tares, beans, or pease. And let two pastures be mowed, and two fed alternately. If the land is poor and light, it will be proper to have five arable fields, of ten acres each, and five pastures of the same size. Let one arable piece be sown with turnips each year; let the turnips be succeeded by spring-corn, and clover and rye-grass sown with it: one field must lie in a layer of the first year; one in a layer of the second year; and the fifth arable piece may be sown with wheat, rye, pease, oats, or barley, after having been a layer two years,

years. And let two of the pastures be mowed in their turn, and three fed. The advantages of arranging the farm in this manner are, that the ploughed fields will produce a regular supply of summer and winter food for the cattle, and corn of different sorts with straw; the pastures will afford grass for the summer and hay for the winter; and be kept in good condition by alternately mowing and feeding. And as the preparation for the different crops upon the arable land will be at different times of the year, it may be tilled with the smallest number of cattle possible. When the fields are brought into the courses above mentioned, one pair of stout oxen will be sufficient for all the business of the farm; and as they will live upon straw, with turnips or cabbages in the winter, with a little hay at the times of sowing, and graze in the pastures during summer, they will be kept at a very moderate expense. Indeed, I think it much better to keep two oxen for that purpose than to do the business of the farm with horses occasionally used in a carriage; because, upon such a system of economy, a prudent man loses the chief convenience of his equipage, and a thoughtless one the best seasons for the work of his farm. But to occupy such a tract of land with only two working beasts, it will be necessary that the fields are contiguous; and the ploughing, harrowing, &c. must be performed in the method commonly used in Suffolk and Norfolk: and the carting of all sorts must be done with two small carts, one for each ox. The practicability of this will appear from a calculation of the time necessary for the ploughing, harrowing, and rolling, which will shew the time left for the other work of the farm. Let us take the annual tillage of the larger quantity of land. Four ploughings for ten acres of turnips, give forty acres; two ploughings for the ten acres of spring-corn, twenty

acres;

acres; and perhaps it may be advantageous to give two ploughings upon the ten acres of corn sown upon the breaking up the layer, which adds twenty acres more; and consequently there will be eighty acres to be ploughed yearly. We know, from experience, that a pair of oxen will plough six acres in a week; but, allowing for interruptions by bad weather, and other accidents, let us suppose them to plough only five acres weekly. Sixteen weeks therefore will be required for the ploughing; and, to give good allowance for the harrowing and rolling, let us add four weeks more for them; so that together they will take up twenty weeks annually; and the remaining thirty-two weeks will surely be thought sufficient for the carting, and all necessary work. Indeed, I can with more confidence assert, that a pair of good oxen will do so much, because with four oxen I occupied a farm several years, where more than twice as much labour was required; and where the difficulty was increased by great part of the arable land being so moist-bottomed, that the oxen could work upon those lands only in dry seasons.

The following may serve as a sketch of the probable expenses and returns of such a farm.

Expenses.	£.
Rent, - - - - - - - - - - - - - - - - -	50
Tithe and town charges, - - - - - - - - - -	20
Labour, - - - - - - - - - - - - - - - -	40
Smith, wheel-wright, and collar-maker, - - - -	10
Seed-corn, - - - - - - - - - - - - - -	10
Interest of stock, - - - - - - - - - - - -	5
Half the expense of a dairy-maid, as she will have time to do other work, - - - - - - - - -	10
Total expenses, - - - -	£. 145

 Returns.

Returns.	£.
Spring-corn, - - - - - - - - - - - - - - - -	25
Corn upon the layer, - - - - - - - - - - - - -	40
Grass or hay, with straw, for six horses, - - - -	60
Produce of six cows, - - - - - - - - - - - - -	30
Profit of hogs and poultry, - - - - - - - - - -	20
Total returns, - - - - - - - - - - -	175
Deduct expenses, - - - - - - - - - -	145
Profit, - - - - - - - - - - - - - £.	30

You see my estimate of the profit is not so great as that of some calculators; but perhaps it is nearer to the truth. But I cannot consider pecuniary benefit as a principal object in a plan of this kind. The advantages arising from it to a gentleman will be more material. He will find in it a pursuit very conducive to health, giving constant and interesting employment without anxiety; with something always to do, and something to expect. The succession of the various crops, and preparations for them, will furnish him with perpetual inducements to take the benefit of air and exercise upon his farm; and he will be freed from the tedious necessity of riding or walking for health's sake only. Let me add, that he who has acquired a relish for such amusements at home will have little occasion for that dissipation which is too often the recourse of those who are, by an affluent fortune, exempt from necessary attention to any profession or trade.

It may not be improper to remark, that this plan may be enlarged or contracted as required; and may often, with advantage, be partially adopted, where it cannot

entirely

entirely, take place. The quantity of land may be increased or diminished, according to the quantity of horses and other stock wanted by the family. Where the soil is unfavourable to the growth of common grass, it would be better to increase the tillage, and rely upon clover, tares, ray-grass, sainfoin, or lucern, both for summer grazing and a supply of hay.

Inquiries respecting the tinning of Copper, Pewter, and Pottery. By M. PROUST.

From the ANNALES DE CHIMIE.

Introduction.

THE doubts which have been raised for two years past respecting the wholesomeness of tinned-copper, and those to which the accidents occasioned by glazed-pottery have given birth, have already created alarm to society. Our government (the Spanish), always attentive to the removal of whatever may injure the public safety, thought it necessary to subject these doubts to chemical examination, in order that as much light as possible might be thrown upon the important question, whether tinning, by reason of the lead which is used in it, sometimes in excess, may expose the health of mankind to the same dangers as glazed-pottery of bad quality.

In order to meet the benevolent intentions of government, it was indispensably requisite to undertake, upon the different kinds of tinning, a series of experiments, the results of which should be sufficiently conclusive to confirm the distrust which had been excited with regard to them, or to dissipate the apprehensions which had sprung from it, if they were founded upon notions merely chimerical. But these researches, such as they might

have

have been expected from a science which reckons the knowledge of metals and of their alloys among the branches of natural history which it has cultivated with the greatest attention, these luminous analyses, so ardently desired by an alarmed nation, have not yet been undertaken.

Nevertheless, it was impossible that one should have forgotten the conduct pursued many years ago, under circumstances full as critical, by the most able chemists, and particularly at the period when indiscreet clamours suddenly spread an alarm throughout all Europe, by exaggerating the dangers to which we were exposed by the use of tin, on account of the arsenic which had been discovered in it. But these useful examples were neglected, and instead of examining, as good sense required, the degree of danger which resulted from the use of lead in tinning, it was imagined that the difficulty might be removed, and the apprehensions of the public quieted, by hazarding the advice to substitute in its place another metal, which has not been sufficiently examined with respect to the effects which its solutions may produce upon the health, and which joins to this inconvenience that of dissolving with the greatest facility in the vegetable acids, and of forming with tin an alloy extremely difficult to be wrought, and very ill adapted for the tinning of copper. And what has been the result? That which might naturally have been expected from an advice founded upon an empirical receipt, extracted from a journal, which not only did not vouch for it, but which did not even answer for its accuracy, a receipt moreover condemned in all its parts by the plainest notions of chemistry and of the practice of the arts.

The difficulties which have presented themselves in the new method of tinning have discouraged the artists. These

These difficulties being now more insurmountable than ever, on account of the want of instruction relative to this new process, have excited a multitude of complaints, which, by perpetuating the apprehensions, have caused the views of government for a time to waver, and have plunged again into the chaos of controversy as well the old method of tinning as the new one, and even the hopes which had been conceived of ameliorating either the one or the other.

The idea of alloying tin with zinc for the fabrication of kitchen utensils, and for tinning copper vessels, has been proposed long since in Europe by men of science, by artists, and by speculators; but in no country has it been founded upon any surer bases than in Spain. It has no where been ascertained by authentic experiments (which alone can convince all minds, and inspire confidence), whether the solutions of zinc, as far as regards their internal use, are so exempt from danger as has been pretended. No academy, no society of chemistry, or of medicine, has yet demonstrated in a proper manner the salubrity of these solutions. Among the persons, otherwise very well informed, who have proposed zinc alloyed with tin as very proper for tinning, and even for fabricating pewter, none has yet undertaken to ascertain, first of all, whether zinc resists better than tin, lead, iron, &c. the solvent action of the acids which exist in our aliments. In a word, some notions, taken from the historical notices which chemists have given as relative to zinc, are the only data which have seemed to authorize the recommendation to employ it for our kitchen utensils.

It is true, that if tin or its alloy could, as has been pretended, supply the place of ordinary tinning, we should

have

have reason to be surprised that Sweden, England, France, and Germany, where we have seen so many projects and demands of privileges for the exclusive employment of this metal, and where so many manufactures were abandoned as soon as established; we should have reason, I repeat it, to be surprised, that these four nations have, as it were by agreement, refused to employ zinc instead of lead, the danger of which is so well known.

Obliged by the confidence with which the government was pleased to honour me, to examine *whether zinc is or is not a proper ingredient for tinning or for pewter*, I thought it necessary to begin with some inquiries upon this subject. Although they are as yet incomplete, I have resolved to publish them, because they appear to me to be sufficient to contribute to the solution of the difficulties which have arisen upon this question, and to dissipate the apprehensions which I believe to be exaggerated. If the object of the sciences be to enlighten the arts with regard to the best and most useful employment of the productions of nature, they ought also assiduously to defend them when the speculations of intrigue or avarice endeavour to molest their peaceful laboratories, by endeavouring to compel them to modes of practice incompatible with the nature of those productions.

In order that I may omit nothing which may enable the reader to obtain a thorough information on this subject, I shall relate, as briefly as possible, the different proposals which have been made, and which have come to my knowledge, for substituting zinc in the place of lead. I shall not employ chemical terms, without explaining them in the notes, because I wish that a treatise, which necessarily concerns the interest of all classes of society, may be read and understood by every one.

1741.

1741. Dr. Malouin was the first who, in analytical researches which he presented to the academy in 1742, and the subsequent years, published that iron and copper might be superficially whitened by means of a layer or a bath of zinc, as they were whitened by means of tin. The advantages which this author found in this new method of tinning were, 1, a hardness which prevented it from being destroyed as soon as the tin; 2, its opposing a greater resistance to liquefaction; 3, its preventing the dangerous effects of lead mixed with tin in excess. But Dr. Malouin did not deny that difficulties would occur in the practice, which would perhaps be surmounted in course of time, or which would render it necessary to abandon this process.

1742. Jean Baptiste Kemerlin presented to the Comte de Maurepas a tin of his composition, of which he would establish a manufactory, on condition that an exclusive privilege should be granted him for that purpose. Hellot and Geoffroy examined this tin by order of the Academy: they found that this alloy was far from coming up to what the author had professed concerning it; but they did not however venture to pronounce explicitly upon its composition, because the analytical processes were at that period not yet in any very advanced state.

In the same year the Academy again nominated these two chemists to examine two white alloys, adapted for making pewter, which even the historian of the Academy compared to a *similargent*, in contradistinction from *similor*, into the composition of which it had previously been ascertained that zinc entered as a constituent part.

Hellot and Geoffroy discovered this time the composition of these alloys, for they succeeded in imitating one of them, by alloying together equal parts of zinc and tin.

But what is deserving of all the attention of the reader, is the account of the properties of one of these two alloys, which they judged to have been composed with the proportions which have just been indicated. This account describes with so much accuracy the defects of this alloy, to which it has been thought necessary to call the attention of our government, that by simply transcribing the words of the report of these academicians, I may dispense with disignating more particularly those which I have latterly discovered in my laboratory with the aid of Don Pedro Blanco, a master pewterer in the street *de la Montera*.

" At the same degree of heat which affects the fusion " of good tin, this is reduced to the form of an amal- " gama, which may be cut with a knife into any number " of parts without their joining again. It does not be- " come liquid until the bottom of the iron spoon in which " the fusion is performed is made red-hot; but then a " very considerable portion of it is scorified, which as- " sumes a blue colour, and which is not reduced or re- " vived into metal, although there has been added wax " and resin, the ordinary means of restoring the parts " which have been disjoined or disguised by scorifica- " tion. Thus there would be much loss upon this metal " whenever it should be fused in order to be cast in a " mould. As it is almost impossible to give it the liquidity " requisite for *assaying it by the stone*, according to the " practice of pewterers, (explained in the History of 1741, " p. 52,) the last metal of the assays which Messrs. Ge- " offroy and Hellot have made with it, that part of the " metal which ran into the groove of the stone was ne- " ver clean and pure like it ought to be when the tin is " of a good alloy. The button which fixes itself in the " hemispherical excavation of the stone is covered at " the surface with an infinite number of needles, which

" is

" is always an indication of a bad tin, the old pewter of " which is hardly of any value. The same tin is also " very difficult to be cast into ingots, &c. *"

The mere reading of this description will suffice to shew how difficult it would be for the pewterers to avail themselves of this alloy, and how inconsiderate the proposal made to government has been.

Having prepared a quantity of this alloy, we found it, when fused, extremely pastey, and, as Geoffroy says, converted into a kind of amalgam, capable of being cut with a knife. The master pewterer who has been mentioned above performed this operation three times, in order to cast a vessel in a mould. At the first trial, the alloy did not run easily enough to fill it. The second was not more successful, for the piece, when he imagined that it might be taken out of the mould, fell to the ground, and was reduced into pieces entirely separate, and having no adhesion with each other. Finally, in order to have a piece well or ill cast, he was obliged to cool his mould entirely with water, and in doing this to lose a space of time which would have been sufficient for casting two of ordinary tin. This vessel of the third trial, which I have preserved, is so full of defects, that it would be difficult to remedy them by endeavouring to make them disappear by means of soldering, according to the method employed by the potters. On examining it we perceive that the last portion of the liquefied metal, during the short space of time that they run to unite to the first, lose the heat and fluidity which they require in order to solder and incorporate with them, and that consequently it is almost impossible to cast a large piece with this alloy.

* Hist. de l'Académie pour 1743, p. 102.

 But

But the most remarkable defect of this alloy is, that from a pound, only the piece mentioned above could be obtained, which weighs not more than nine ounces: all the rest was burnt and reduced so rapidly into scoria, whilst the piece was taking out of the mould, that it was impossible to make any use of the residue for a second fusion. If, as must naturally happen, the loss resulting from this alloy falls upon the purchaser, the pewterer will thus be obliged at least to double the price charged for each piece.

Time has also brought to light another defect in this metal, which alone would be sufficient to induce us to renounce its use.

The vessel of which we have spoken above lost entirely, in the space of a month, its original lustre; an earthy colour, interspersed with black spots, took place of its brilliancy; and now, after a lapse of six months, this vessel is as it were powdered or covered with a white efflorescence, which, when examined with a magnifying glass, clearly shews that its surface has been oxydated by the air. This circumstance demonstrates, in the most convincing manner, that this alloy has a greater tendency than any known alloy to become oxydated of itself; for this oxydation takes place in the ordinary degrees of heat of our atmosphere.

All that has been said will be rendered still more evident by comparing the vessel in question with ten other vessels which I have kept, fabricated with different alloys of lead and tin, and which have not yet lost their original lustre.

What would the working-man or the house-wife think, who should see this fine powder form upon their kitchen utensils. Should there not be reason to apprehend that some one, imbued with vulgar prejudices, the natural fruit

fruit of ignorance, might take this kind of flour for arsenic? Is it not enough that we employ for domestic uses two metals subject to rust, and should we wish to augment their number without any attendant utility that might compensate for this increase of expense?

Such, however, is the nature of the metal which it has been thought fit to propose to the public, as very proper to be substituted, for ordinary uses, in place of tin alloyed with lead.

But if the least reflection be bestowed upon the subject, it will be perceived that, in order to establish this innovation upon solid foundations, it would be necessary first of all to accredit it to the public, and by an instruction grounded upon well-made experiments to illustrate all the points of practice of a method entirely new to the two classes of artisans who would have to carry the projected alloy into execution. It would be requisite previously to smooth all the difficulties in order to deprive repugnance or indolence of all their pretext for opposition: it would especially be necessary, in order to convince the really or pretendedly incredulous, to demonstrate that this alloy was in no wise prejudicial to health, or contrary to the interest or the taste of that innumerable multitude of persons who might furnish the consumption.

It is only by familiarizing the public with these notions that it would be possible to dispose them to adopt this reform. Moreover, it must be evident that the proposal to abandon suddenly a metal which is already known, for another which does not appear to be so, even in the laboratories of the chemists, could not fail to give rise to serious disputes, and to the following questions, which must be started in every quarter:

Is

Is it demonstrated that the old alloy is prejudicial to health?

Is it demonstrated that that which is proposed is more salubrious?

Will the workmen prepare this new alloy with as much facility, and at as reasonable a rate, as the old one? and will they not be obliged, in order to accomplish it, to go through as it were a new apprenticeship?

Would it be possible to tin with this alloy like with the old one, and if insurmountable obstacles should be met with in it, would it be requisite for all the braziers of the kingdom to resort to the chemical laboratories in order there to learn the practice of this operation?

Has the new alloy as agreeable an appearance as the old one?

Is it not subject to rust, or to communicate an unpleasant taste to the aliments?

Could the pieces of this alloy be renewed or fused over again with as much facility and as little loss as those of the old one?

In case that the present utensils should become proscribed in our domestic operations, must we throw them out of the window? or have any measures been fixed upon for employing the alloy of which they are made in the arts, in order that the owners may not be too much prejudiced against relinquishing them?

All the zinc that exists in Madrid does not amount to two *arrobes**: whence is it intended to procure the requisite quantity of this metal, and when may we expect it to arrive, &c. &c.?

It is evident that prudent and reasonable chemists cannot expect that the solution of all these questions shall be furnished by the meditations of the artisan.

* The *arrobe* is 25 lbs. Castile weight.

Let

Let us now see how this alloy comports itself in vinegar, which is the acid which we employ the most in our culinary operations. I put a plate of this alloy into a vessel filled with vinegar; on the following day the alloy had already contracted a disagreeable metallic taste. On the third day this taste, without being sweet, astringent, or bitter, had become insupportable. If we might judge of it by a metallic flavour which resembles that of the sulphate of zinc, considered in medicine as an emetic, it could hardly be doubted that half a spoonful of a metallic solution which nature has not ranked in the class of alimentary mixtures, must excite violent vomiting. A plate, having a surface of two inches, was put into vinegar, and boiled in it for the space of half an hour; and during this time the plate lost sixteen grains of its weight; whence it must be concluded, that a vessel composed of this alloy, which should present to the vinegar a foot of surface, would in a similar operation lose an ounce of its weight.

A certain quantity of vinegar was boiled in a kettle tinned with the new alloy, according to the method proposed; and this vinegar was found to have a taste as disagreeable as that of the preceding experiments.

A plate of the same alloy which was left for three days in distilled vinegar, which is much weaker than common vinegar, saturated it entirely with its bad taste. The solution was examined with the greatest attention, and not an atom of tin was found in it, because this metal is infinitely less soluble than zinc.

According to all these results, confirmed, as will appear, by the commissioners of the Academy of Sciences at Paris, it may be asserted that a metal which dissolves so easily, and which is consequently so much disposed to mix with our aliments; that a combination not less disagreeable by its taste than suspected with regard to its effects,

effects, ought not to enter into the composition of our kitchen-utensils or into the tinning of copper, especially when nature has given us for the same uses metals exempt from danger according to general acknowledgment. We shall adduce hereafter other arguments not less cogent, which militate against the introduction of zinc into our kitchens.

1778. Doucet, author of the project of a new kind of pewter, sent in this year to the Academy of Paris, an ingot and a kettle of his metal. Macquer and Montigny were nominated to examine it. These chemists, whose knowledge in the art of analysis was far superior to that which had been possessed in the times of Geoffroy, soon discovered that the new utensils which had been so pompously announced in the public journals, as intended to expel copper from our kitchens, were nothing more than an alloy of zinc and tin. They even added that the kettles of Doucet were found to be very brittle when they were made to support the same degree of heat as is ordinarily applied in the kitchen-stoves to those of copper.

These chemists began to recognize the nature of Doucet's alloy by the bright phosphoric flame produced by its combustion; for wherever this flame is observed, it always indicates the presence of zinc. On the other hand, the application of the nitric acid by dissolving the zinc, and producing that white powder or oxyde which characterises tin, fully convinced them of the nature of the alloy *.

* When we apply this acid to the metals which it is able to dissolve, they always at first decompose it in part; they seize upon one of its principles which is termed oxygene, and they then become soluble in most of the acids.

The solution of the zinc in vinegar likewise takes place only after the oxydation of this metal, which is effected by the oxygene of the water.

The same kettles, these academicians add, when put to heat with a little vinegar, dissolved with a remarkable effervescence, and at the same time they became covered with a white powder; phenomena which really belong to the solution of the alloy of zinc and tin. The vinegar, kept cold in these kettles, and evaporated, afforded at the end of eight days a beautiful crystallization, very white and ramified, which was nothing else than the acetate of zinc, or the combination of vinegar with its oxyde.

The same academicians mention in their report, that one Chartier had also presented to the Academy a new kitchen-utensil tinned with zinc, and that it was rejected because it was attacked by the acids and the neutral salts. They terminated their report by saying, "that the effects of the salts of zinc, taken inwardly, were not sufficiently known to enable them to pronounce them not injurious."

M. de la Folie, a man of information, and a great friend to the arts, to the progress of which he contributed much at Rouen, his native city, decided in favour of iron kettles tinned with zinc, in order, he said, to guard himself not only against the copper and the lead which corrupts the tinning, but also against the tin itself, on account of the arsenical particles which Geoffroy had suspected in it, and which Margraaf, some years before, had demonstrated to exist in most tins.

However, this combination of metals was not adopted in France, or in any part of Europe, according to the information which I have been able to collect, notwithstanding the confidence which might naturally have been inspired by the use which M. de la Folie and other individuals made of it in their own houses, and the offer which was made in the Journal de Physique to teach the

process of this tinning gratuitously to all who should apply to him for it. The apprehensions which M. de la Folie excited upon this occasion, by speaking of the arsenic contained in the tin, and which, a little time after, spread consternation through all France, were yet not able to conquer the repugnance which was felt against making use of a method of tinning, the salubrity of which did not appear to be sufficiently warranted by the example of some individuals, themselves seduced by the flattering idea of furnishing society with novelties which they conceived to be of utility.

One of the principal defects of this composition was, according to the Abbé Mongez, an impartial judge, though a friend of the author's, that it communicated heat too quickly, and required too much attention on the part of the cook to prevent the aliments from being burnt.

To these defects must be added those which Macquer has indicated, as we have shewn, in the tinning with zinc; namely, that of being too easily attacked by lemon-juice, verjuice, and vinegar, which consequently would speedily leave the iron exposed. It is known with what facility wrought iron blackens vegetable substances on account of the acid, astringent and extractive principles which they contain in greater or less quantity.

Another inconvenience, of a not less serious kind, in the use of iron lined with zinc and even with tin, is that the tinning cannot be renewed without immersing the pieces in a bath of fused metal, as is done in the fabrication of white iron. Hence we may judge what a quantity of zinc it would be necessary to keep in fusion in order to line in this manner a kettle of only a foot in diameter, and how much charcoal and time would be expended upon a single operation.

La Folie also made some experiments upon Doucet's metal. He found that the alloy of zinc and tin, in equal parts, was harder than tin and more malleable; but when he wanted to try, at a potter's, to cast some vessels, he met with difficulties which he had not foreseen, and which were probably the same as those described by Hellot and Geoffroy, and which have been confirmed by my experiments.

As to the apprehensions which were conceived in France on account of the arsenic contained in the tins of Europe, every one knows that they were soon dissipated by the work which Bayen wrote upon this subject by order of the police of Paris, and in which this excellent chemist observes that a plate of tin, which he had employed for two years at all his meals, had lost only four grains of its weight, and that the arsenic which could be contained in these four grains, detached by scouring the plate rather than introduced into the stomach, did not amount probably to $\frac{1}{5750}$ of a grain *per* day.

1802. Finally, the Journal of Arts and Manufactures has announced that the tinning with tin and zinc had lately been proposed by M. Buschændorf, of Leipzic. We shall transcribe the article for those who do not possess this journal.

"The operation is commenced with the first tinning, which is performed with fine tin in the ingot, and sal ammoniac (muriate of ammoniac) instead of resin. This first layer serves only to cover the copper uniformly, and to provide a medium for combining the tinning with this metal. As a second harder, more united and more uniform layer is to be given, it is necessary to commence with that. For this second tinning we take two parts of fine grain tin and three parts of zinc; we apply it upon the surface of the first tinning with the aid of sal ammo-

 niac,

niac, but in such a manner that the inferior layer remains entirely covered. The addition of this semi-metal renders the tinning harder and more solid. It is then passed again and flattened under the hammer, after having previously been cleaned with chalk and water: this precaution is indispensable, in order to render the surface united and compact. The inventor of this operation has in this manner tinned several vessels within and without, in order to prevent the oxydation of the copper in all its parts; but to effect it, he strongly heated the pieces after having scraped them, and plunged them first into a bath of tin, and afterwards into an amalgam of zinc and tin, in the proportions which we have just indicated.

"There is another manner of tinning which is very durable, but more expensive, on account of the great number of metals which enter into its composition, though its durability might compensate for the greater expense. The following is the composition: one pound of fine tin, an ounce and a half of filings of malleable iron, a drachm of cast platina, twenty-four grains of mercury, and three grains of gold."

The author says afterwards, that the whole must be fused with borax and pulverized glass, formed into ingots, that these must be reduced to powder, fused again, and drawn into thin plates. All this is so laborious a preparation that we shall content ourselves with observing that such a specification is not very likely to gain credit for the happy results which the author pretends to have obtained from the first.

Let us return to his first tinning, since it is the base of that which it has been attempted latterly to introduce.

It is more durable, the author says. In order to prove this, it would have been necessary to compare pieces tinned

tinned with fine tin with those executed according to his method.

It strengthens the copper vessels. The strokes of the hammer which must be applied to the pieces after the tinning, may strengthen them by destroying the flexibility which they have received from the fire; but this operation is attended with great inconveniences.

The first is, the necessity of separating the handles of the kettles in order to be able to pass them again under the hammer, without which this operation repeated two or three times would be sufficient to convert the circular form of their orifices into an oval.

The second is, that the pieces are rendered thinner every time they are hammered, whereby consequently their solidity and durability are diminished.

The third consists in augmenting considerably the price of the tinning; so that a kettle, the tinning of which ordinarily costs six reals, could not, according to my experiments, be hammered for less than six reals more. When the author proposed so expensive a mode of tinning, he ought at least to have demonstrated that the excess of the price would be compensated by its duration, and not to have taken it for granted that it would be believed upon his assertion.

The fourth inconvenience is, that not all kitchen-utensils are capable of supporting a second operation of the hammer, similar to that which they undergo under the hand of the workman who forms them. There are moulds destined for making ices and pastry which have not cost less than four, eight, ten, twelve, and even sixteen great piastres. Let, for example, one of these utensils be tinned, and you will see what a price the brazier will charge for smoothing it afresh, and hammering it in all its dimensions. Let the poor artisan have his choco-

late-

late-pot tinned, which sometimes is as thin as paper: the first stroke made with the hammer, in order to flatten down the asperities, will break it all to pieces. There are, however, among the kitchen-utensils many other articles which require tinning as indispensably as those, but the tinning of which it will be impossible to execute in all their parts without exposing the owner to superfluous expenses, and having them speedily destroyed.

But, it will be said, one might tin the vessels without passing the whole of the tinning again under the hammer. I reply, that this is not possible. Give a cook one of those pots which has not passed under the hammer; it will be impossible for him to stir the spoon about to his fancy, and disgusted with such an utensil he will soon throw it aside.

It preserves the culinary vessels from the action of the acids more effectually than the ordinary tinning. It appears that the author is not very well informed with respect to the difference in the solubility of the metals.

The application of the first tinning must be begun with sal ammoniac in place of resin. Sal ammoniac is a foreign article, which is sold at present at twenty-four reals the pound, whilst resin, which is a production of the country, sells at only four quartos *. Why therefore prefer this salt to resin? It is proved that resin possesses all the advantages that can be desired for facilitating the adhesion of the tin to the copper. It is equally proved, that in the tinning of a large article the vapour of the sal ammoniac greatly incommodes the operator, whilst resin is exempt from this inconvenience.

Let a dishonest workman be authorised to employ sal ammoniac in place of resin, it will happen that when he

* Nearly half a real, or two-pence halfpenny.

shall

shall hardly have expended two quartos of salt upon a tinning which has cost him four of resin, he will raise the price of his work, without any person's being able to complain of it; for he will silence those who object to the charge, by simply telling them that the sal ammoniac costs him twenty-four reals.

Let us then not attempt to introduce into the practice of the arts ingredients both expensive and useless, and let us believe that the body of braziers, in refusing to employ sal ammoniac, have given very laudable proofs of probity and disinterestedness.

For the second tinning are to be taken two parts of tin and three parts of zinc. Pure tin, and common tin, or that which is alloyed with lead, are met with in commerce, but no pure zinc. The following is the ordinary state of this metal in Europe.

Zinc is rarely extracted in a direct way from its ores. It escapes and is spontaneously volatilized during the fusion of the ores of lead, which besides contain copper, arsenic, iron, &c. By means of the refrigeration which is provided in this operation, in the anterior part of the furnace, the condensation of a portion of zinc in effected, and it is this portion which in the form of bricks is sold in commerce, and employed in the arts; this metal, as it is volatilized, carrying away a small portion of the metals which accompany it, as I have already observed. The zinc which comes to us from Rammelsberg, from Saxony, &c. which is the only kind that is seen at present in Spain, for want of that of Alcaraz, is in this state. The Annales de Chimie are full of memoirs which prove its habitual impurity. It is true that arsenic, copper, and lead exist in this zinc only in a small quantity; but setting aside at present the arguments which an effeminate delicacy might found upon this small portion of lead, arsenic,

arsenic, and copper, I would know from the author of the new tinning and his party, what they find so commendable in zinc, to induce them to offer it to us as the palladium of salubrity, and to propose it as a preservative against the dangerous effects of lead and copper.

Louis Patrin, a mineralogist of great reputation, says, "the German physicians prescribe zinc as a vermifuge; it is a very purgative emetic." Was Patrin, who knows Germany as well as his own house, perfectly assured of what he affirms? This I cannot take upon me to decide. Let us return to the propositions of M. Buschaendorf.

If zinc be a metal so proper for tinning, and if it must preserve us from the dangers of copper, why has the proportion indicated by the author been diminished among us? why employ it at first in equal parts, when Buschaendorf prescribes two of tin and three of zinc? why afterwards take three parts of tin to one of zinc? Does this uncertainty proceed perhaps from the circumstance that the method prescribed by the author was deemed impracticable? On this subject no doubt can be entertained.

We shall soon see whether these ameliorations facilitate the tinning with zinc. In the mean time we may take it for granted, that the new proposed method of tinning is, with a very slight difference, of the class of so many others which we find in books, and which are brought forward from time to time, and produced as arcana.

TO BE CONTINUED IN OUR NEXT.

Means

Means of giving to red Copper the Colour, the Grain, and the Hardness of Steel. By M. SAGE.

From the JOURNAL DE PHYSIQUE.

MARGRAFF and Pelletier have communicated to the public their researches respecting the union of phosphorus with different metallic substances, a process which the French chemist brought to greater perfection. By repeating and varying his experiments, I discovered that the most certain and most expeditious means of phosphorating copper, was to take this metal in the metallic form, to fuse it with two parts of animal glass and a twelfth of charcoal-powder; but it is of essential consequence that the copper present much surface, an advantage which is to be obtained by taking cuttings of this metal and placing them, layer by layer, with the animal glass mixed with charcoal-powder. I expose the crucible to a fire of sufficient activity to fuse the glass upon which phosphorus is formed, the greater part of which burns, whilst another part combines with the copper, in which it remains so incarcerated that it is not disengaged from it, although in fusion for twenty minutes under the animal glass which has not been decomposed.

When the crucible after cooling has been broken to pieces, we find under the glass, which has passed into the state of red enamel, the phosphorated copper, in the form of a grey and shining button. On weighing it the copper is found to have been augmented one-twelfth by this operation.

If the fused phosphorated copper falls upon a plate of polished iron, it extends itself in the form of strata, variously configurated, which have a chatoyant appearance, like a dove's throat.

The phosphorated copper is much more fusible than red copper; it may often be fused under charcoal-powder without losing any of its properties.

The same phosphorated copper, when exposed for a long time under the muffle, separates from the phosphorus only with great difficulty.

The copper thus combined with phosphorus acquires the hardness of steel, and also the same grain and colour; like it, it is susceptible of the most beautiful polish; it is easily turned, and it is not altered by exposure to the air. I have kept for fifteen years in my laboratory buttons of phosphorated copper, which have not undergone any alteration. The copper does not exhale any odour when it is rubbed: if it were ductile it would be of the greatest utility, for fatty substances do not appear to have any action upon it.

In the phosphoration of the copper only a part of the animal glass was decomposed, because there was not employed a sufficient quantity of charcoal to phosphorate the whole of the acid; but it is necessary that this should be so, in order that the vitreous scoria may be sufficiently fluid for the phosphorated copper to disengage and collect itself with facility.

The deep-red enamel which is formed in this experiment may be employed with advantage for porcellain and enamelling, as this red is not altered by fire.

Copper cannot combine with phosphorus except in the dry way. If we put a cylinder of phosphorus into a solution of nitrate of copper, diluted with from four to five thousand parts of water, we find at the end of eight days the copper in a metallic, crystallized, and ductile state, forming a case round the cylinder of phosphorus.

Memoir on Milk and on the Lactic Acid.

By M. Bouillon-Lagrange.

From the Annales de Chimie.

§ 1. *State of our Knowledge respecting the Lactic Acid.*

The chemists who have contributed the most to make us acquainted with the nature of milk, and its chemical composition, are Scheele, Deyeux, and Parmentier.

The experiments undertaken before these able men, belong to Hoffman, Boerhaave, Homberg, Geoffroy, Rouelle the younger, and Baumé. But the analysis of the animal substances was at their time still in so imperfect a state, that there was but little to be collected from their experiments.

The labours of Scheele were directed by very different views; his ingenious experiments led him to determine the characters and properties of an acid which is afforded by the serum of milk. Notwithstanding the labours of this celebrated chemist, something still remained to be desired respecting this substance.

"Besides the great number of its saline compounds," says M. Fourcroy, "which are still wanting to the science, Scheele has not indicated the action of fire upon this acid, its spontaneous alteration by the air, the manner in which it comports itself with the nitric acid, &c.: it is not known whether it is totally decomposed by the latter, or converted into another acid, especially the oxalic. We are wholly ignorant of its intimate nature and composition; though it presents properties which nearly resemble those of the acetous acid, and which even lead to suppose that it is very nearly allied to it; it is not yet possible for me to rank

 "it

" it among the vegetable acids. On the other hand, I " am as little able to decide relative to its animal nature, " since no experiment has yet demonstrated the presence " of azote in it, and since we are ignorant whether it " can afford ammoniac in its decomposition, whether it " is putrescible, whether it can be converted into Prussic " acid, &c."

This passage, while it exhibits the state of our knowledge respecting the lactic acid, traces, as it were, the course which we have to follow in order to determine the rank which this acid ought to hold in the number of well-ascertained chemical facts.

§. 2. *On Milk and the caseous Matter.*

Before I give an account of the experiments which I have made upon this acid, I conceive it useful to premise some reflections upon milk and its constituent parts.

M. Guyton, in the *Encyclopedie Méthodique*, presents two questions upon the existence of the acid in milk. This chemist expresses himself as follows.

Does the whey exist in milk, such as it is found after the separation of the other constituent parts? Does it not exhibit acid properties only by reason of the salts which it holds in solution, as all the analyses suppose?

If the whey, adds the same chemist, existed in milk such as it is found after the separation of the butyraceous and caseous parts, nothing more would be required for re-producing milk than to mix these three principles again in the same proportions. Whence he concludes that the whey is the product of a real fermentation.

The examination of this first question, founded upon his experiments, must prove, I think, that it is not sufficient, in order to ascertain whether whey exists in milk, to re-produce milk by mixing the three principles together

ther in the same proportions; 1, because these principles are no longer the same; 2, because, according to the process which has been followed, the whey is more or less acid.

First Experiment.

Milk recently drawn reddens the paper and tincture of turnsole.

Second Experiment.

If we distil milk in close vessels, and divide the products, the first is not acid; the second reddens turnsole, and slightly precipitates the nitrate of silver; the third has no longer any action upon the tincture. At this period the milk is not yet decomposed, it still reddens turnsole. It appears that the acid which remains is no more volatile, and that it is retained either by the animal matter or by some other substance.

Third Experiment.

If we coagulate milk with a mineral or vegetable acid, the whey is separated without retaining a particle of the acid employed.

I observe, however, that we might be under an error, if we examined only the serum obtained either by the sulphuric acid or by alum, for the precipitate which barytes gives is not entirely re-dissolved by the nitric acid. I have convinced myself that it was owing only to the decomposition of a small quantity of sulphate of potash which the serum contains: of this we have an evident proof, when we employ whey which has been separated by any other substance that is not acid.

Fourth Experiment.

If we expose milk to the air at a temperature of 12 to 20 degrees, the separation takes place in twenty-four hours.

hours. The coagulum has a more marked acid taste than that of the third experiment. Hot water deprives it of its sour taste, and reddens turnsole.

We thus find again here nearly the same properties in the caseous matter spontaneously formed, and in that which is separated by the acids.

Fifth Experiment.

The same experiment, made with the pneumato-chemical apparatus, occasioned no absorption of air, or disengagement of any elastic fluid; only, the separation of the caseous matter was not effected till at the end of several days; one part of it swam upon the liquor, the other occupied the bottom of the vessel.

Sixth Experiment.

A bottle was filled with fresh milk, and accurately corked; at the end of some days the caseous matter was separated. As soon as the separation appeared complete, it was attempted to draw the cork, but it quitted the bottle with violence, and a whizzing sound which indicated the presence of an elastic fluid. When the bottle was shaken, a greater quantity of gas was disengaged, which, when collected and examined, presented the same characters as carbonic acid.

The liquor, as well as the coagulum, had an acid taste, very pungent, which was weakened in proportion as the carbonic acid was disengaged from it by agitation.

The liquid, after having been heated, did not appear to be more acid than the serum, which had been obtained from milk exposed during the same time to the air.

The same experiment was made with milk which had boiled about half an hour; the phenomena were the same.

Seventh

Seventh Experiment.

The caseous matter procured from the third, fourth, and fifth experiments, differs essentially in taste and consistence.

That of No. 3 is dry and firm; that of 4 is more divided and less dry; a portion of it dissolves in water.

Finally, that obtained from Nos. 5 and 6 is not grumous; it is more light, and does not unite in a mass till at the end of several hours.

The caseous matter therefore acquires peculiar properties according to the substances and the processes employed for separating the serum.

These first experiments lead us to the following reflections.

1. That milk does not require to be decomposed in order to manifest the presence of an acid;

2. That this acid is mixed with salts, the saccharine matter, and an animal matter;

3. That the acid in the milk is free, but that this free state is not very perceptible except by the re-agents;

4. That the contact of the air is unnecessary for isolating the constituent parts of milk;

5. That the coagulating substances only facilitate the separation of the curd, either by forming a new compound, or by bringing the molecules into more immediate contact; then the caseous matter acquires new properties; or, finally, when the milk has been exposed to the air. Gradually a part of the sugar of milk is decomposed; carbonic acid is formed, a part of which is disengaged, and the other facilitates the separation of the coagulum; caloric also favours the attraction of the coagulating substances for the curd. They all act differently, for alcohol, which has also this property, produces other

other results; the curd may, to a certain degree, be redissolved in water. We cannot therefore, as chemists have asserted, attribute these effects to the solution of these matters in the water, and to their having a greater attraction for this liquid than the caseous substance has.

Of this the muriate of soda, and especially the muriate of lime, affords us the proof. These salts effect the separation of the curd only in part, and yet the muriate of lime has a very great affinity for water; the decomposition ought then to be effected in a more marked manner than with the acids.

Whey is therefore not the product of a fermentation. If alcohol is obtained from milk, this does not prove that in order to obtain the lactic acid it is necessary that this formation should take place, for we may obtain the lactic acid from a serum recently prepared.

As to the formation of the carbonic acid, indicated experiment six, it is owing to the decomposition of a small quantity of animal matter, and to a part of the sugar of milk dissolved in the serum; the more that is decomposed of these substances, the more of carbonic acid is formed; also the degree of acidity is more marked by reason of the presence of the carbonic acid; but if we come to expel the acid, the serum is sweeter, and has less acidity than that which has been exposed for some time to the air.

If we expose the serum to the air for the space of ten or twelve days, in proportion as the saccharine matter is decomposed, the whey becomes more acid; these degrees of acidity are owing to a small quantity of acetic acid formed with the aid of the carbonic acid and alcohol, that has remained in the liquor, which naturally must augment the acidity of the acid already formed in the milk.

As to the second question: does not whey manifest acid properties only by reason of the salts which it holds in solution?

I have proved that the acid might be isolated from the saline matters without exposing the milk to the air for a greater or less space of time, as Scheele has indicated; the experiments which I shall report in this memoir will furnish additional proofs. Thus its acid properties do not depend solely upon the salts which it holds in solution, and the lactic acid is not produced by a fermentation analogous to the acetous.

Though the action of caloric upon milk is generally known, I shall however make an observation upon the acid which is obtained in distillation by naked fire, and which has for some years past been termed zoonic acid.

If we purify this acid, and combine it with potash, the result is a salt which presents all the characters of the acetate of potash.

I shall also remark, that in the caseous matter in which some chemists have not been able to find the phosphate of lime which Scheele had announced, it really exists. In order to obtain it, it is sufficient to heat this substance strongly in a crucible, after having washed it well, and to calcine to whiteness.

There remains a hard white matter, some pieces of which, veined with blue, may be compared to the Turquoise.

The nitric acid dissolves them without effervescence; lime-water and ammoniac occasion in them a flakey precipitate of phosphate of lime.

The oxalate of ammoniac also demonstrates the existence of the lime in it.

§ 3. *On the Serum of Milk.*

Wishing to know whether there existed any differences in the wheys obtained by different substances, I employed mineral acids, some vegetable acids, salts, such as alum, the acidulous tartrite of potash, &c. The coagulating matter was employed with the proper precaution, having remarked that when an excess of acid was used, it was found again in the serum, whereas when only the necessary quantity is added, the cheese alone seizes it.

After the caseous matter had been separated, the serums were clarified; the wheys had all the same taste and the same colour, and indicated the same degree of acidity.

If fresh whey turns the syrup of violets green, this property must be attributed only to the union of the yellow and the blue, not to the saline matters, as chemists have asserted; whey which has lost its colour, by exposure to the air, reddens the syrup of violets.

The means employed for ascertaining the presence of the acids which had served for coagulating the milk, could not discover the smallest quantity of them, especially, I repeat it, when the operation has been performed with accuracy.

I tried, by way of comparison, serum which had soured in the air, and obtained by exposure of the milk; the phenomena which I have indicated § 2, experiment 3, were precisely the same.

The following are the circumstances in which the spontaneous serum differs: 1, its taste is more acid; 2, its colour is dull and whitish, owing to white filaments, which separate themselves from it. By filtrating we may obtain it clear, but it never has the colour of fresh whey.

The

The caseous matter resulting from the different experiments mentioned above, gave the same red with the tincture of turnsole; if we calcine and treat it, we may, by the known re-agents, demonstrate the presence of the sulphuric acid in it, if this acid has been employed for coagulating, and of alumine, if alum has been used, &c.

I do not see therefore any inconvenience which can arise to the preparation of whey for pharmaceutical uses, from coagulating the milk with either of the above-mentioned substances, especially with the precautions which I have indicated; those who have supposed it to be prejudicial to health to coagulate with alum, had no doubt made no experiments on the subject.

The action of lime-water, of the solution of barytes, of strontian, and of some metallic salts, although already known to chemists, deserved to be examined anew; it will soon serve me for the explanation of the processes for obtaining the lactic acid.

§ 4. *Of the Sugar of Milk.*

The formation of the acetic acid is not owing merely to the alteration of the sugar of milk; and though the experiments which I have already quoted allowed me some conjectures, I have ascertained whether one might obtain an equal quantity of sugar of milk from fresh serum and from serum which had been exposed for twelve days to the air, and to a temperature varying from fourteen to twenty degrees.

I found that the soured milk afforded a little less sugar of milk, which proves that a portion of the saccharine matter has served for the formation of a quantity of acetic acid.

We may therefore obtain the carbonic acid, the alcohol and the acetic acid, both in close vessels, and when the whey remains exposed to the air.

 Other

Other experiments made upon the pure sugar of milk presented to me nothing remarkable.

It does not redden the tincture of turnsole. Dissolved in water, and exposed for a long time to the air, it does not turn acid. In distillation it gives, besides the known products, acetic acid.

It dissolves in the weak acetic acid; if we add a [illegible] quantity of fresh caseous matter, we soon perceive that the liquor holds some of it in solution, by pouring in some drops of alkali, in order to saturate the excess of acid; from being transparent it becomes turbid, milky; it has a sweet taste, analogous to that of milk, and it preserves for a considerable length of time its opacity.

From the facts indicated in these four sections it results:

1. That milk newly drawn reddens the tincture of turnsole;

2. That we may separare the caseous matter from it without the contact of the air;

3. That the serum does not retain the acids which have been employed to coagulate the milk;

4. That the distillation of milk to dryness, and that of the sugar of milk, give acetic acid;

5. That the formation of the carbonic acid and of the alcohol is owing merely to the mucoso-saccharine matter.

6. That a quantity of acetic acid is formed by the fermentation of these substances;

7. That the caseous matter, when it has just been separated, always manifests the presence of an acid, and that it differs in taste and consistence, according to the matters which have been employed for separating it?

8. That when well washed, and giving no indication of acidity, diluted afterwards in distilled water, at the end of some days, and in a temperature between fifteen

and

and twenty-two degrees, it acquires a strong disagreeable smell; the water slightly reddens turnsole; lime disengages ammoniac from it;

9. That the serum and the caseous matter contain, besides the known substances, phosphate of lime, as Scheele had announced;

10. That the difference which exists between fresh serum and that which has been exposed to the air, consists in the circumstance that there is acetic acid added to the acid which is free in the milk;

11. Finally, that there exists in milk and in the serum a free acid, which has appeared to me to be acetic acid.

§ 5. *On the Lactic Acid.*

Scheele having discovered that it was not possible to obtain the acid by a simple distillation, had recourse to particular means for effecting this separation.

This chemist first reduced the whey to an eighth by evaporation; he filtrated it, and there remained, he asserts, no more caseous parts in it.

He saturated the liquor with lime-water, and the phosphate of lime was precipitated. This liquor having been filtrated and diluted with thrice the quantity of water, he poured into it oxalic acid by drops, in order to take up again and precipitate all the lime; he convinced himself by the addition of a little lime, that there remained no oxalic acid in it. He then evaporated the liquor to the consistence of honey; the inspissated acid was dissolved again in rectified alcohol; the sugar of milk, and all the other substances foreign to the acid, which had not been dissolved by the alcohol, remained upon the filtre. Finally, after having again added a little water to the acid held in solution by the alcohol, he caused the latter to

to pass off by distillation, and he found in the retort the lactic acid.

This very long and expensive process does not yield a pure acid. It was therefore necessary, previous to examining its nature, to seek a more simple process.

First Experiment.

If, instead of exposing the whey to the air, as Scheele indicates, we perform the process immediately, we obtain only a very small quantity of acid less coloured, and of a more animal smell.

This acid has appeared to me to be that which is found free in the milk, on account of the small quantity obtained.

Second Experiment.

Instead of employing lime-water and oxalic acid, I used barytes or strontian and sulphuric acid; and I obtained an acid as pure as by the process of the Swedish chemist.

Third Experiment.

I had also tried the acetate of lead in order to decompose a lactate of potash, expecting to form a lactate of lead decomposable by sulphuric acid; but the precipitate which is formed is not a lactate of lead, for when we add the sufficient quantity of sulphuric acid with the intention of decomposing, we render no acid free. It appears that a part of the oxyde is precipitated with animal matter; this compound is even a little soluble; besides the liquor always retains much acetate of lead in distillation.

Thus, though this process has been indicated as superior to that of Scheele, it is certain that it cannot be employed for obtaining the lactic acid. The experiments which follow have been made upon the lactic acid of Scheele.

1. We

1. We may diminish the intensity of its colour by triturating red-hot charcoal in a mortar, and pouring lactic acid upon it; a quantity of small flakes are separated, which rise to the surface. It was slightly boiled and filtrated; the acid was then less coloured and less odorous.

2. When we distil this acid in a retort, acetic acid passes over, and a thick, yellow, very acid matter is left behind.

It might perhaps be thought that a part of this acid is changed into acetic acid with the aid of the caloric, as M. Berthollet observes. (Statique Chimique.)

"The ternary acids," says this chemist, "may be changed into acetic acid, when, by the action of heat, they abandon a part of their carbon, and their elements, which resist this action less, are separated and volatilized."

I have convinced myself that a great part of this acid existed in it before.

3. The same phenomena take place, but in a more marked degree, if we distil whey which has been exposed to the air to a temperature from fifteen to twenty degrees, during the space of about fifteen days. The first product is a clear transparent liquor, of an acid taste and an alcoholic smell, which, combined with potash, forms an acetate. If we add alcohol to what has remained in the retort, it becomes coloured; when it has been decanted and distilled, we find in the retort an acid of a peculiar animalized smell, similar to the preceding; but the acid contains a very small quantity of phosphate of lime.

These experiments come in support of the observations which I have made, 1, that we obtain by the process of Scheele a mixed acid, 2, that an acid exists in whey newly prepared. We must now endeavour to ascertain the nature of this acid.

For

For this purpose I prepared lactic acid according to the process of Scheele, with all the requisite precaution. I even assured myself previously of the purity of my alcohol; distilled upon muriate of lime, it marked forty degrees by Reaumur's areometer.

The lactic acid dissolved in the alcohol was subjected to distillation. There passed into the receiver an alcohol which reddened the tincture of turnsole.

When the acid was totally freed from the alcohol, the distillation was discontinued. There remained in the retort Scheele's lactic acid, of a yellow colour, and a very acid taste.

First Experiment.

I mixed quick-lime with this concentrated acid. Ammoniac was disengaged *.

Second Experiment.

If we form a lactate of potash, and evaporate it with a gentle heat, there is separated a brown matter, insoluble in water; heated afterwards in a crucible, the salt swells up, and diffuses an animal odour. The presence of the prussic acid has been proved by dissolving the remaining matter in water, and adding to it a little solution of sulphate of iron.

Third Experiment.

If we add sulphuric acid to lactic acid, or to a lactate of potash, not only a disengagement of acetic acid takes place, but also an elastic fluid, which forms a thick cloud when it is in contact with ammoniac.

* I had already ascertained the presence of azote in this acid; I announced it the 18th Nivose to the Society of Pharmacy; M. Vauquelin, who did not know it, told me at the reading of the first part of this memoir, that he had also recognized the presence of an animal matter in the lactic acid of Scheele.

Fourth

I

Fourth Experiment.

When we distil the above mixture in an apparatus adapted for receiving the gaseous product into water, the distilled water of the flask preserves its transparency; the odour of the acetic acid is strongly marked; it reddens turnsole, and precipitates the nitrate of silver.

Moreover, a small quantity of ammoniac was approached to the tube from which the gas was disengaged, and a very thick cloud was formed.

Fifth Experiment.

What remained in the retort was evaporated to dryness; a very acid brown matter was obtained, which, when heated afterwards in a crucible of platina, swelled up, and left a coal, which was incinerated.

During this operation a small quantity of sulphuric acid was decomposed.

The matter which remained in the crucible was dissolved in distilled water. The solution did not redden turnsole, but it gave a brown tinge to paper stained with curcuma; sulphuric acid was added to saturation, evaporation was performed, and by cooling, crystals were obtained which presented all the characters of the sulphate of potash.

As the supernatant liquor had a metallic taste, prussiate of lime was poured to it, which produced a blueish tinge.

The infusion of galls caused it to pass into a brown.

Sixth Experiment.

We may still evaporate the lactic acid to dryness, heat it in the crucible to incineration, dissolve it then in distilled water, and precipitate it by the nitrate of silver. There is formed a muriate of silver, which we separate by

by the filter; the liquor which contains the nitrate is evaporated, and it is decomposed by fire. There remains a white matter, which, dissolved in water, gives with the tartarous acid an acidulous tartrite of potash.

I conclude that the lactic acid of Scheele is composed of

Acetic acid;

Muriate of potash;

A little iron, perhaps, held in solution by the acetic acid; and

An animal matter.

Analysis and Decomposition of a Liquor employed for rendering Cloth impermeable to Water.

By M. Vauquelin.

From the Bulletin des Sciences.

IT is well known that for several years past different persons have successfully occupied themselves with rendering cloth impermeable to water: an object of great importance for the equipment of sea and land forces.

The inventors of this process have hitherto kept the means which they employ secret; there was only reason to suspect that some fat oil formed the basis of their applications, but it has not yet been demonstrated by experiment.

A bottle of this liquor, the efficacy of which was ascertained, having fallen accidentally into my hands, excited in me the desire of investigating its composition; but before I give an account of the method which I followed for that purpose, I shall describe its physical properties.

It is a white, milky, opaque liquor, having a bitter taste, and a smell of soap: it presents, like milk, a kind of

of cream at its surface, and it strongly reddens the tincture of turnsole. I imagined, according to these properties, that it was merely a solution of soap, the taste and smell of which it still retained, which had been decomposed by an acid; but further experiment soon shewed me that there was something else in it.

Experiment I.

In order to know whether I could separate by filtration the white matter which rendered the liquor turbid, I put a certain quantity of it upon *papier Joseph*; it passed for a long time turbid and milky; but by pouring it several times upon the same filter, I at length obtained it as clear as water; after which I tried separately the liquor and the matter which had been left upon the filter.

Experiment II.

If my conjecture had any foundation, I ought to have found in this liquor only the base of the soap united to the acid, of which there was a superabundance in it. My first care was to ascertain the nature of the acid; and what the taste had already nearly indicated to me was confirmed by the muriate of barytes, which produced in it an abundant precipitate that was insoluble in nitric acid: thus I was already assured that this liquor contained sulphuric acid; but, on the other hand, ammoniac having formed in this liquor a white flakey semi-transparent precipitate, I saw that there was something else in it than the salt resulting from a decomposition of soap.

Experiment III.

I then precipitated a certain quantity of this liquor; I washed the matter and dried it. As it had all the physical characters of alumine, I combined it with sulphuric acid; I added to it a little sulphate of potash, and I obtained, by

by a slow evaporation, very fine alum. Thus we have already in this liquor sulphuric acid and alumine undoubtedly united to each other in the state of alum.

Experiment IV.

It was now necessary to ascertain whether the liquor from which I had separated the alumine did not still contain some other substance; and first I subjected it to some trials by the re-agents, among which the oxygenated muriatic acid and the infusion of galls discovered to me a new substance in it. The first rendered the liquor milky, and soon after produced white flakes in it; the second produced yellowish white flakes, in much greater abundance than those which proceeded from the effect of the muriatic acid. I then suspected that this liquor contained, besides the matters already mentioned, an animal substance, particularly gelatine.

Experiment V.

In order better to ascertain the nature of this substance, I evaporated the liquor to dryness with a gentle heat. I obtained a yellowish salt, of a bitter taste, which, when dissolved again in water, left a yellow matter, in the form of pretty voluminous and very gluey flakes, which as they dried assumed a kind of elasticity. This substance, put upon burning coals, swelled up, exhaling white fumes which had the odour of ammoniac, and of the fetid oil which the animal matters generally yield.

I was now convinced that a certain quantity of animal gelatine had been put into this composition, with the intention, no doubt, by giving more viscosity to the liquor, to hold the oily parts for a longer time, and more completely in suspension. It is probably by the effect of heat, and perhaps by a commencement of decomposition, that the animal gelatine has become insoluble in water; but

but I perceived that the liquor, in which the salt was, still retained some of it in solution, for muriatic acid and the infusion of galls, still formed precipitates in it, only less abundant than the first time.

Experiment VI.

By this experiment I endeavoured to ascertain the nature of the fatty matter which had been left upon the filter, and of which I have spoken above; my design was especially to know whether it did not hold some other substance in combination.

For this purpose I burnt it with the filter in a crucible of platina: it exhaled a vapour similar to that of tallow or the oils; it left a cinder, of which the filter had furnished a part, and in which I again discovered the presence of a small quantity of alumine, which can be attributed only to the oil; for the *papier Joseph* did not contain an atom of it. I believe even that this oil contained also, with the alumine, a small quantity of animal matter, but this I could not positively ascertain.

Thus, notwithstanding the excess of acid which existed in the liquor, the oil, in its precipitation, carried along with it, and retained in combination, alumine, and probably animal gelatine.

The substance, therefore, which, by uniting with the cloth, renders it impermeable to water, is not merely oil, but a combination of this matter with alumine, and probably with animal gelatine, which must render this property more durable.

Experiment VII.

The liquor which I successively deprived of oil, of alumine, and in part of animal matter, by the different means above indicated, yielded me, by a slow evaporation

ration, crystals of salt composed of soda and of sulphate of potash.

Experiment VIII.

I performed the analysis of this liquor better by another process, which I shall relate here but very briefly.

I precipitated the alumine and the oil by means of lime-water; I united, washed, and calcined the deposit; what remained in the crucible was alumine and lime.

The liquor from which these matters had been separated, being evaporated to a certain degree, yielded sulphate of lime, a certain quantity of animal matter which had become insoluble by the desiccation of the liquor; finally, sulphate of soda and potash containing still animal gelatine, insoluble in water.

The following is the manner in which I conceive that this liquor has been prepared, *the proportions excepted.* Soap and glue, or any other gelatine, were dissolved in water; with the solution of these substances was mixed a solution of alum, which formed in the mixture, by being decomposed, a flakey precipitate, composed of oil, of alumine, and of animal matter; then weak sulphuric acid was added, in order to re-dissolve a part of the alumine, to render the precipitate lighter, and to prevent its being deposited; but the alumine, having been once combined with the oil and the animal matter, no more dissolves again entirely in the sulphuric acid, and it is on this account that the oil remains always very opaque, and neither rises nor is precipitated. It is evident that we must not add too large a quantity of sulphuric acid. I do not know whether this be precisely the manner in which the operation is performed; I only know, that by following this method I have succeeded in composing a perfectly similar liquor, which possesses the same properties.

On

On the Decomposition of the alkaline Sulphurets by the Oxydes of Lead and of Manganese. By M. Dizé.

From Van Mons's Journal de Chimie, et de Physique.

If we mix charcoal with an alkaline sulphate, and expose the mixture to a high temperature, the oxygene, which is a constituent part of the acid, burns the charcoal, and abandons the sulphur which served as its radical; but the alkali combines with the sulphur, and forms what is called an alkaline sulphuret.

This combination of the sulphur with the alkali, which is a result of the decomposition of the alkaline sulphates by the charcoal, is not so easy to be destroyed as might be imagined, especially when we operate upon pretty large masses. The frequently repeated exposure of the alkaline sulphurets to a managed heat, is not sufficient to cause the volatilization of the sulphur; the alkali retains enough of it to render it improper for certain operations in the arts; besides, the sulphur, in being volatilized, burns in part, and forms sulphurous acid, which combines with the alkali. The operation, instead of being simplified, is rendered more complicated, since we obtain only an alkali mixed with sulphuret and alkaline sulphite.

The addition of the carbonate of lime to the mixture of charcoal and of an alkaline sulphate, as it was practised in the first manufactory of soda, established at St. Denys, near Paris, was not an expensive means of facilitating pretty speedily the decomposition of the sulphuret of soda which was the result of the sulphate of soda, decomposed by the charcoal; nevertheless the soda appeared still to be mixed with sulphuret and with sulphite of

of soda, which were easily distinguished by the smell, and in the crystallization of the salt of soda. The mixture of iron in place of carbonate of lime, or these two substances employed in conjunction, did not give a better result. The whole of the alkali could not be obtained in a pure state till after repeated washings, calcinations, and crystallizations.

Such is still the state of our knowledge of the means of purifying in the large way, and without incurring too great an expense, the alkalies which may be prepared by the decomposition of the alkaline sulphates.

These difficulties which appear of little consequence in the operations of the laboratory become very embarrassing in large manufactories, where the results ought to be equally speedy and easy to be obtained.

I shall speak in preference of the sulphuret of soda proceeding from the decomposition of the sulphate of soda by the process employed in the manufactory of St. Denys, near Paris, and which was published at the time by order of government. This process is still the most simple and most easy to be executed in the large way; at least it has been judged so according to experience. I believe that the result of my researches upon the decomposition of the sulphurets must add to its perfection, and afford some indication of which use may be made in analogous operations.

Without entering into the details of all the experiments which have led me to this improvement, I shall now state the means which I employ for decomposing the alkaline sulphurets, or freeing the soda from the last portions of sulphuret and alkaline sulphite which it contains.

After having proceeded to the decomposition of the sulphate of soda, by the mixture of charcoal and carbonate

nate of lime, we lixiviate the crude soda, in order to extract the alkali from it. This lixivium is commonly of a yellowish colour, and exhales the odour of sulphur; if we mix with it some drops of diluted sulphuric acid, sulphur is precipitated, and hydro-sulphurated gas and sulphurous acid are disengaged with violence.

Were we afterwards to evaporate and crystallize this lixivium, we should obtain crystals of soda, from which diluted sulphuric acid would disengage hydro-sulphuret and sulphurous acid. The rest of the liquor would give soda less pure than the first crystallization.

In order to purify this lixivium, and free the alkali from the sulphur which it contains in solution, and cause the sulphite to disappear, I add to the ley, while it is in ebullition, a sufficient quantity of well pulverised semi-vitreous oxyde of lead. This oxyde separates the sulphur from the alkali, and forms by its combination an insoluble sulphuret of lead; the sulphite disappears and is converted into sulphate. The semi-vitreous oxyde of lead loses its red colour, and assumes a deep chesnut or blackish hue, by reason of the quantity of sulphur which the alkali contains. The liquor or lixivium becomes as clear as pure water; the dilute sulphuric acid disengages from it only carbonic acid gas, and forms no precipitate; in a word, this lixivium precipitates the nitrate of lead in a white state, and the sulphate of copper is a beautiful green, whilst, previous to the addition of the semi-vitreous oxyde of lead, the same lixivium precipitated these two metals of [illegible]y dark chesnut colour, that is to say, in the state of sulphuret.

Thus the semi-vitreous oxyde of lead, in the humid way, carries off the sulphur from the alkali of the soda, and may serve for purifying in the large way, and in a very easy manner, the soda proceeding from the decomposition of the sulphate of soda.

 After

After my experiments, and the calculations of the expence which the semi-vitreous oxyde of lead, which I had first employed, might occasion, I have substituted for it, with the same success, the oxyde of manganese, well pulverized. The oxyde of manganese, which is less costly, presents also a valuable advantage, namely, that it may serve several times for the same operation, after it has been freed from the sulphur by calcination.

This facility of separating, by the humid way, the sulphur from the alkali of the soda, without however engaging it in a new combination, that is to say, leaving it isolated and dissolved in the liquid, induced me to make use of this means for decomposing the sulphuret of barytes, and my attempt was not without success.

Decomposition of the Sulphuret of Barytes.

Generally, in order to obtain barytes in a caustic state, the sulphate of barytes is decomposed with charcoal, from which first operation results a sulphuret of barytes soluble in water; then this sulphuret is decomposed with nitric acid; distillation separates the nitric acid from the barytes, and this alkali remains pure and fixed at the bottom of the retort. This process is extremely expensive, on account of the large quantity of nitric acid which one is obliged to employ. Barytes will certainly become a very valuable substance for the arts, when we shall be able to procure it at a reasonable price.

The following is the most simple and the most economical means which I have discovered, and which I had a long time practised for my own use.

When the sulphuret of barytes is made by the decomposition of the sulphate of barytes and charcoal, I dissolve it in water; after having let it settle and clear itself, I decant it into a vessel, in which I boil it, adding to it pulverized

pulverized oxyde of manganese, till the liquor has lost its yellow colour, and is become clear and limpid.

In proportion as the oxyde of manganese separates the sulphur from the barytes, the odour of sulphur diminishes, and instead of it an alkaline odour is perceived; the taste of the liquor, when all the sulphur is combined with the manganese, has a considerable degree of causticity; as soon as it cools, if we have not employed too much water for the solution of the sulphuret, the barytes crystallizes round the vessel.

The nitrate of lead and the sulphate of copper are precipitated from their solvents by the caustic barytes, the first in a white, and the second in a blue form; thus the oxyde of manganese has a stronger affinity with sulphur than the alkali of the soda and caustic barytes, since this oxyde, at the mere degree of ebullition, decomposes these alkaline sulphurets completely. This process appeared to me simple enough to be applied to the preparation of these two alkalies upon a large scale, so as to afford them at a reasonable expense to the arts in which they may be used.

Since the time when I perceived that the oxyde of manganese attracted, in the humid way, the sulphur from the fixed alkalies and from barytes, this means has been a great assistance to me in getting rid of the alkaline sulphurets in many analytical operations, in which the presence of the alkaline sulphuret embarrassed me, without my requiring an acid to decompose it.

The soda and the barytes prepared by this process are very pure, and come to a very moderate expense, especially the barytes.

 Of

Of the mathematical Law of the Propagation of Heat.

From the BULLETIN DES SCIENCES.

IF heat passes from a body to be communicated to those which surround it, what portion will each of these receive? what relation will there be between their respective distances and the degree of their calefaction?

Count Rumford and M. Biot have occupied themselves with this question; but as they have arrived nearly at the same result, we shall record here only the experiments of the latter, which are remarkable for their simplicity and their fertility of application. He immersed the bent extremity of a bar of iron into a constantly uniform source of heat. Such a one is easily obtained, for it is known that as long as a body is melting or boiling, it preserves the same temperature. M. Biot therefore employed successively boiling water and mercury, tin and lead, in the act of fusion, &c. Placing afterwards thermometers into holes made in the bar, at equal intervals, causing the ambient air to act equally upon all, and waiting till they had all risen to the point at which they were to stop, he examined their respective heights.

In order now to foresee what must happen, it is sufficient to admit this principle, that the quantity of heat, which a hot body communicates to a cold one in a very short time, is proportional to their difference.

Thus we easily conceive, and the detailed calculation demonstrates it, that the different points of the bar must be by so much the colder as they are more remote from the source of the heat, and that their different temperatures will represent a descending geometrical progression, the

the first term of which will be the temperature of the source, and which will descend the more rapidly in proportion as the nature of the bar is less adapted for the propagation of heat.

To this is superadded the refrigerating action of the surrounding bodies; but supposing the bar to be as much isolated as possible, the air of itself tends to cool it; and as, according to the principle admitted, it acts upon every point proportionately to the difference of its temperature from that of this point, what it takes away from all these points is likewise in geometrical progression, and consequently what they retain is still so.

If therefore, with an equal heat of the source, we place thermometers at determinate distances upon one and the same bar, and we know the height of one, we shall be able to calculate that of all the others, by having regard to their distance from the source.

This is what M. Biot has tried; and he has always found that the real heights corresponded to the calculated heights within a very trifling matter.

Hereby he has not only given the proof of the truth of the principle from which he set out, but he has also deduced from it a very useful application. In order to measure very high degrees of heat, it does not require an instrument adapted for being immersed in those degrees; it is sufficient to expose to them the extremity of a graduated metallic bar, and to apply thermometers to some determinate points of its length: we may then easily calculate the temperature of the heated extremity, and if we multiply the number of thermometers, and employ successively bars of several sorts, the common result of all these observations is susceptible of the most rigorous precision.

We

We also see why a bar of iron, only six feet in length, can never be sensibly heated at the one extremity by plunging the other into any heat whatever; it is because the geometrical progression of temperatures which belongs to iron, and which depends upon the conductibility of this metal, descends too rapidly for that purpose.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Breeding Sheep.

A FARMER at Warcot, in Yorkshire, produced this year from twenty-four ewes seventy lambs, *viz.* twenty-two ewes produced three lambs each, and one ewe four lambs; the lambs in good health and strong. The increase was supposed to have arisen from having turned the ewes into rape prior to the ram being turned to them.

Weeding Machine.

The Rev. T. Brown, of Connington, near St. Ive's, offers to all agriculturists an implement which he thinks is of the utmost importance, and worthy the notice of those persons who are desirous of cleansing their land from every kind of weed. It will work upon any soil, but more particularly upon light, and it has been used, and that continually, upon the heaviest. It is worked by either two, three, or four horses, according to the roughness of the tillage, and will raise upon bean-stubble on the strongest soil sufficient tilth in a mild season to harrow wheat in, without any previous ploughing. It requires only one person to attend it, and that is the driver, as it will keep steady to its work by itself. By employ-

ing

ing two sets of horses it will clean from six to eight acres each day. — This implement is to be regulated (so as to cut any depth) with the greatest ease.—As a proof of the utility of this implement, the possessor had last year a very foul fallow field, thistles nearly as high as his knees: having ploughed this fallow once, the cleanser was made use of every time there appeared any sort of weed upon the land, to the amount of fifty acres; which lot of land is now wheat, and has been weeded twice over this year, and has cost the occupier 11*s.* 7½*d.* the whole fifty acres. —The last year was the first time of the Rev. Mr. Brown's making use of this implement. — The price of this machine with wheels twenty guineas, without wheels sixteen guineas.

Tanning.

M. Hermbstädt, of Berlin, has discovered that the *Tormentilla erecta*, a plant which grows almost every where, and the *Polygonum bistorta*, furnish excellent materials for tanning leather. If, for instance, a pound of dry hide requires seven pounds of oak-bark to tan it completely, the same weight of hide requires only a pound and a half of Tormentilla, or three pounds of Bistorta. He likewise employs the leaves of the oak-tree with advantage in the operation of tanning-leather.

Hydraulic Machine.

M. Trouville has made a new hydraulic machine, which throws up water to a great height without any other mechanism, and solely by the rarefaction of the air in air-tight stone chambers, placed one above another. For this invention he has been presented with a gratuity of 15,000 livres by the Board for the Encouragement of Arts and Sciences at Paris.

List

List of Patents for Inventions, &c.

(Continued from Vol. V. Page 464.)

ROBERT FRITH, of Broughton, in the county of Lancaster, Dyer; for a method of dyeing cotton-wool, cotton-twist, cotton-weft, and cotton-cloth of a nankeen colour and of a buff colour. Dated October 3, 1804.

THOMAS PORTHOUSE, of Hall Garth, in the parish of Haughtonle Skern, in the county of Durham, Flax-spinner; for a machine for hackling flax and hemp, and at the same time carding the tow. Dated October 6, 1804.

JAMES CALDWELL, of Hathern, in the county of Leicester, Frame-smith, and JOHN HEATHCOTE, late of the town and county of Nottingham, but now of Hathern aforesaid, Frame-setter-up; for machinery and apparatus to be attached or annexed to certain frames or machines called or known by the name of warp-frames, whereby these frames will work, make, or manufacture all kinds of thread-lace. Dated October 17, 1804.

SAMUEL BENNETT, of Sheffield, in the county of York, Cutler; for a mode of making or casting razors in a new and improved form. Dated October 20, 1804.

THOMAS NOON, of Burton-upon-Trent, in the county of Stafford, Watch-maker; for a thrashing machine with loose beaters. Dated October 30, 1804.

JACOB BUFFINGTON, of the city of Bristol, Gentleman; for a method of straining or stretching (technically called habiting) all kinds of woollen-cloth for cropping or shearing, and for straining all other kinds of piece goods. Dated October 30, 1804.

STATE LOTTERY,

Begins Drawing 28th this Month.

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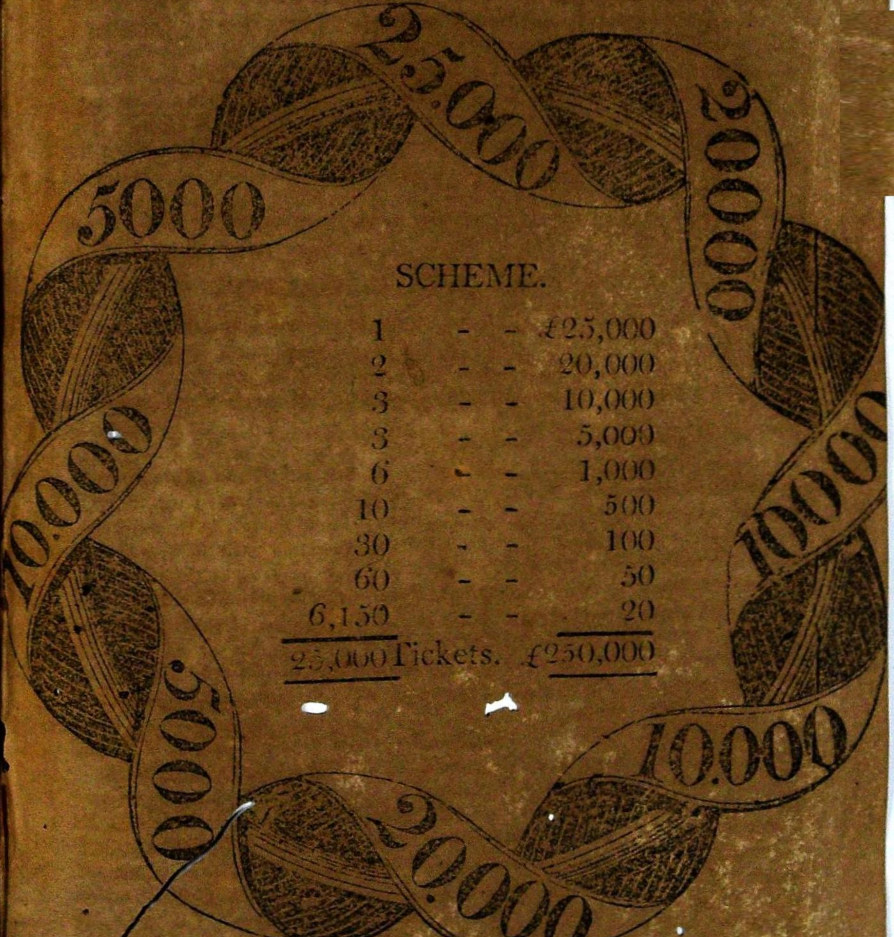

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The Publisher of the Embellished Edition of the British Classics having repeatedly been solicited to undertake a *New* and *Uniform* Edition of the British Poets, respectfully submits to his Subscribers and the Public, the Prospectus of a Work which he trusts will be found to reconcile what, in such a series of volumes has long been so desirable, and yet apparently so incompatible—elegance of execution, and a moderation of price hitherto unexampled.

It is proposed to publish the Poetical Works included in the editions of Dr. Johnson and Mr. Bell, excepting a few of inferior merit, by whose exclusion room will be obtained for such ancient Authors as are thought more worthy, or such modern Writers as the lapse of time since those publications renders essential to the completion of the work. To accompany them, the Biographical Prefaces of Dr. Johnson will be given in an uniform manner, in the early part of the progress of the Work; and, at its conclusion, a Supplement, containing the Lives, with Critical Observations on the Works, of Authors not comprised in Dr. Johnson's plan,

BY THOMAS PARK, ESQ. F.S.A.

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